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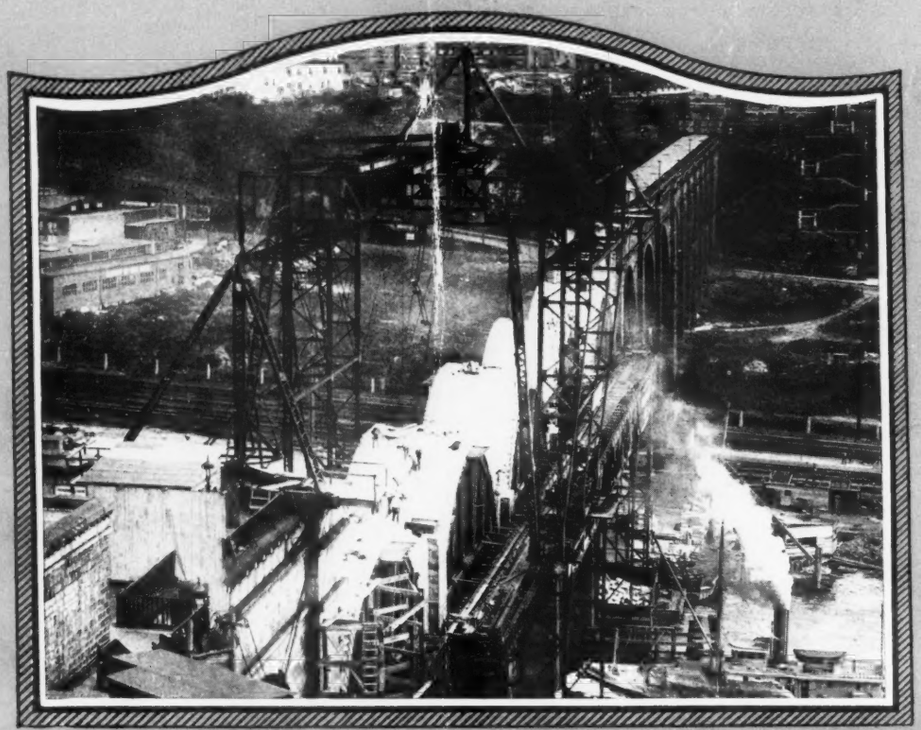

REMOVING FOUR STONE PIERS FROM HISTORIC HIGH BRIDGE TO GIVE BETTER FAIRWAY FOR SHIPPING ON THE HARLEM RIVER, NEW YORK

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Waukesha Engined Haiss Snow Loader in New York

Gasoline's Conquest of Snow

No longer is business in New York afraid of being snow bound at this time of the year. Jack Frost is giving way to King Petroleum. Self-propelled machines now make short shift of the worst blizzard. Automobile sweepers and snowplows keep traffic lanes open. Windrows they make are promptly picked up by snow loaders. Big drifts disappear before mobile cranes. Caterpillar propelled power shovels and portable air compressors quickly break up caked ice and load it on the huge motor trucks that carry it away. Certainly a dramatic expression of gasoline's conquest but---

Reliable and ample power must be provided to accomplish these wonders with modern Industrial Machinery. The engine converts gasoline into power. Waukesha "Ricardo Head" Engines are known all over the world for their economy of fuel, high power output and unquestioned reliability. In New York you will find practically 100% of the snow fighting machinery powered with Waukesha engines varying from 50 to 125 horsepower in size. Write for "Industrial Bulletin" telling about their uses.

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Compressed Air Magazine

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VOL. XXXII, NO. XII

DECEMBER, 1927

One Hundred Years of Railroad Progress

Baltimore and Ohio Celebrates a Century of Service By a Unique and Picturesque Pageant and Exhibition

By R. G. SKERRETT

THE "Fair of the Iron Horse," held recently at Halethorpe, Md., brought home to more than 1,000,000 people how land transportation in the United States has improved in an amazing manner in the course of the last 100 years.

The fair and its associate pageant were staged to commemorate a century of service to the public on the part of the Baltimore & Ohio Railroad. At the outset, the management of the railroad declared that it would be satisfied with its gratuitous exposition if the historical show were visited by 100,000 people. The enterprise, however, proved so spectacular and attractive that more than ten times the expected attendance crowded through the gates during a period of only three weeks. It was a source of general regret that the fair could not be prolonged.

The entire undertaking was especially successful because every effort was concentrated on the single aim of bringing home to the people of America how much has been done by the first-class railroads of the country to provide better, speedier, and safer means of rail transportation. In this age of haste and diversified demands upon our time, relatively few of us pause long enough to consider the steps by which we have reached the conveniences now placed at our disposal. The "Fair of the Iron Horse" made it vividly clear to the visitor just how far forward railroad engineering has gone during the 100 years since the Baltimore & Ohio was organized as a common carrier of passengers and freight. The story thus vitalized was of a nature to arouse enthusiasm and pride in the most phlegmatic of those privileged to enjoy the open-handed hospitality of that trunk line.

Halethorpe lies a few miles west of Baltimore and contiguous to the main line of the Baltimore & Ohio Railroad; and the site chosen for the Centenary Exhibition was in a picturesquely situated tract of 1,000 acres owned by the road. One of our accompanying illustrations gives an airplane view of the fair grounds and shows the great oval stretch of track upon which historic floats and self-driven locomotives of early and modern types passed in review daily before a canopied grandstand capable of seating 12,000 spectators.

THE Centenary Exhibition of the Baltimore & Ohio Railroad was referred to, editorially, in our November issue, but space then made it impossible for us to do justice to that historically instructive show financed by the railroad and run gratuitously for the entertainment and the enlightenment of the public at large.

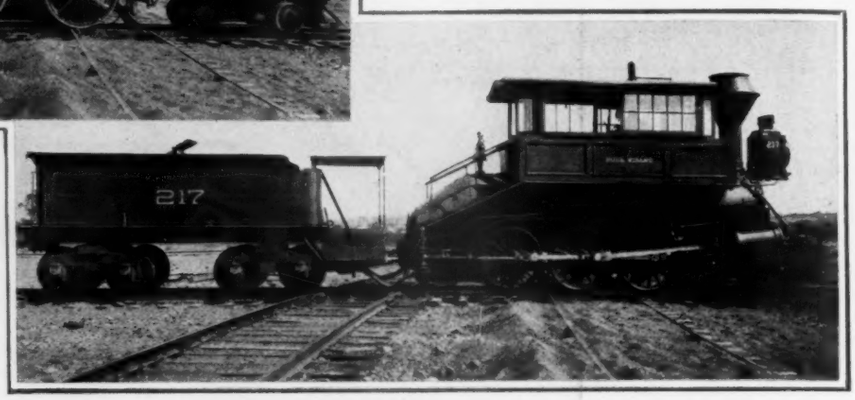
The accompanying article has been prepared to give our readers a fuller grasp of the nature and the extent of the wonderful display made at Halethorpe, Md., and the reasons for it. The Baltimore & Ohio there performed a great public service and set an example that should be encouraged because, in this hastening age, relatively few of us realize the steps by which rail transportation has been brought to its present high state for our benefit.

Railroading in America has been full of romance and amazing achievements; and the Baltimore & Ohio Railroad, at Halethorpe, made these easier for the visitor to visualize and to evaluate.

In the Hall of Transportation—a structure of brick and steel, 60 feet wide and 502 feet long—were housed models illustrating the first conception and the subsequent development of the locomotive. In the same building were other exhibits marking the progress made in cars, bridges, brakes, signaling apparatus, etc., in the course of five-score years. In the Traffic Building, also of brick and steel, were exhibits typifying the stages by which the modern trunk and suitcase have evolved from the carpetbag and the clumsy hide-covered trunks or boxes of our forebears. Likewise, there were shown the changes made in the form and the character of timetables, passenger waybills and rate sheets, tickets, etc., since the first days of the Baltimore & Ohio Railroad's service to the public.

In still another structure of steel and brick —the Allied Services Building—were displayed, through the courtesy of the Western Union Telegraph Company, the original model of the telegraph instrument with which Prof. Samuel F. B. Morse, its inventor, sent his epoch-making message over the wire extending from Baltimore to Washington along the right of way of the Baltimore & Ohio Railroad. Other exhibits marked the progress made in telegraphy since that memorable May 24, 1844. Through the courtesy and the coöperation of the American Telephone & Telegraph Company, the evolution of the telephone was also shown; and there were other exhibits indicating the development of both express and railway-mail services during the 100 years now coming to a close.

To make it more colorful and impressive, the mechanical pageant was supplemented by a parade on the broad roadway in front of the grandstand. Fully 500 persons participated in this part of the show—most of these being drawn from the personnel of the railroad. The



Top—The locomotive "William Mason" was built in Taunton, Mass., in 1853 the somewhat revolutionary idea of by William Mason, who introduced producing machines that were both useful and beautiful. Manifestly, tastes have changed since then.

Bottom—The "Camel-Back" locomotive of 1869. The engineer's cab surmounted the boiler so that the locomotive would not be too long. Ideas about permissible length have radically altered in the meanwhile.

exceptions consisted of a group of Indians of the Blackfeet Nation, and the engineers and firemen in charge of locomotives placed on exhibition by other railroads of this country, Canada, and England.

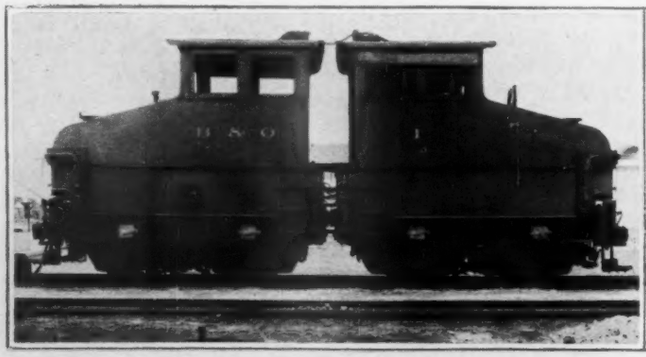
The pageant opened with the Indians symbolizing the early crude and slow methods of travel prevailing within the continent when the white man appeared. Then, came on foot, or drawn by oxen or horses, the various conveyances by which passengers and freight were moved overland for many decades after civilization touched the shores of America. Further, to make still truer these reproductions of other days, the actors were garbed in the dress and styles of the past.

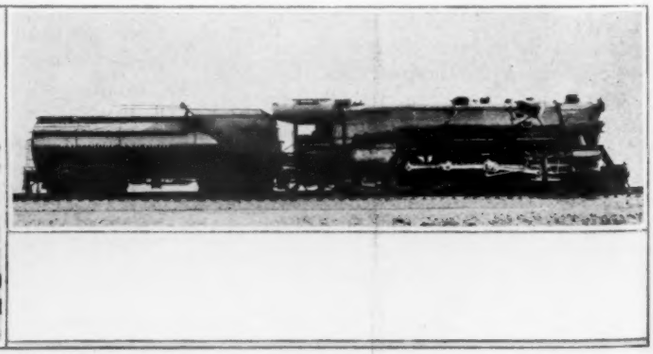
The methods of water transportation were typified by motor-driven floats moving upon the pageant tracks. These depicted the pioneer wanderings of Pere Marquette; the crude *bateau* by which the first of our settlers traversed our great interior waterways; and, then, how man-built water highways, in the form of canals, made the carriage of freight and passengers possible and did much to promote intercourse and to stimulate industry throughout wide sections of the land.

And then the pageant vivified the birth of the Baltimore & Ohio Railroad; and from that time onward the stages of progress in motive power and rolling stock were exemplified either by originals or reproductions as true to fact as they could be constructed. Thus, once again, the *Tom Thumb* built by Peter Cooper moved under its own power upon the rails. And, similarly, the *York*, the prize-winning locomotive of 1831, rolled along easily under steam. This was the first locomotive to be put into regular service on the Baltimore & Ohio, supplanting, to that extent, the horses that had done the regular hauling on the line up to that time. Successively, and under their own power, were exhibited locomotives of divers sorts and sizes—culminating in the mechanical giants that now handle the heaviest and speediest of freight and passenger trains.

For two hours and more, every week-day afternoon, this spectacular parade passed in review—each feature of the thrilling show falling into line and holding its place at the center of the stage according to a pre-arranged schedule. The clockwork-like manner in which the show was run was a striking example of the kind of efficiency that makes the operation of our complex railroad systems possible. In a way, it typified the climax of 100 years of service, during which the Baltimore & Ohio has gone steadily onward in its efforts to please the public and to give both shippers and passengers the utmost for their money. And now the curious—those that were not able to visit Halethorpe but did hear about the "Fair of the Iron Horse"—will ask, Why did the Baltimore & Ohio feel warranted in holding such a celebration and in financing it apparently without stint? We can answer this only by sketching briefly the story of the Baltimore & Ohio Railroad from the time of its conception down to date.

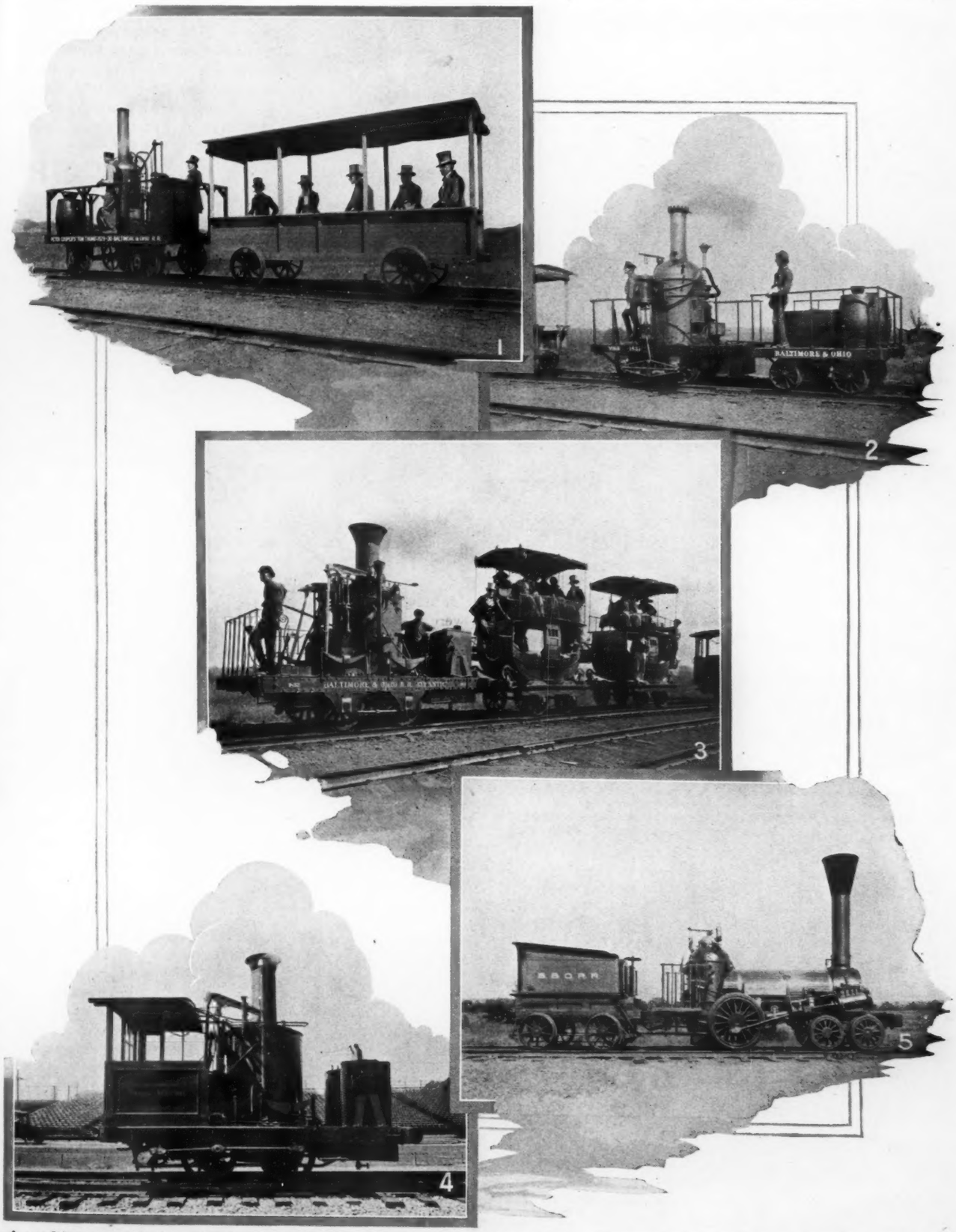
During the first quarter of the nineteenth century, many canals were dug or work upon them authorized by the states immediately concerned. These were built or planned to provide "economy of access to market," as well as to facilitate passenger traffic under conditions often more enjoyable than travel by stagecoach. The completion of the Erie Canal, with its contact with the sea through the Port of New York, proved highly successful in booming business in New York City; and in proportion as the Metropolis gained in this respect Baltimore suffered a diminution of trade. This fact was primarily the promoting cause of the chartering of the Baltimore &



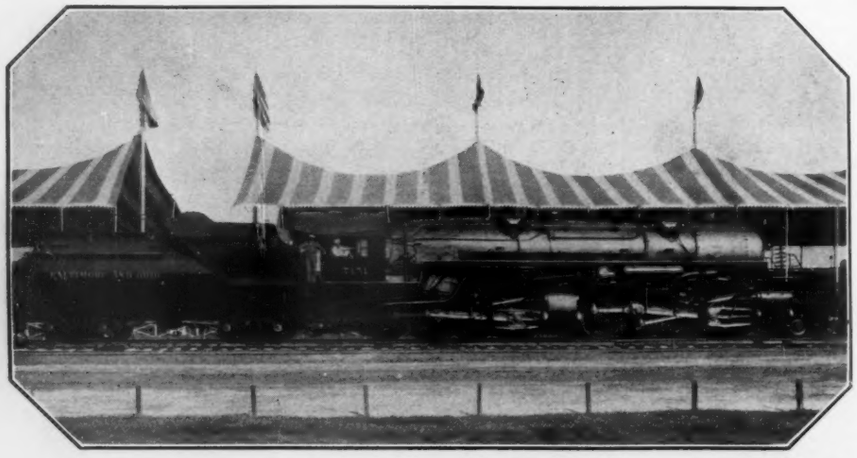


Left—Type of electric locomotive used for the first time in trunk-line service in 1895 by the Baltimore & Ohio Railroad. The railroad adopted this method of hauling its trains through the tunnel in Baltimore to insure greater comfort to passengers in transit.

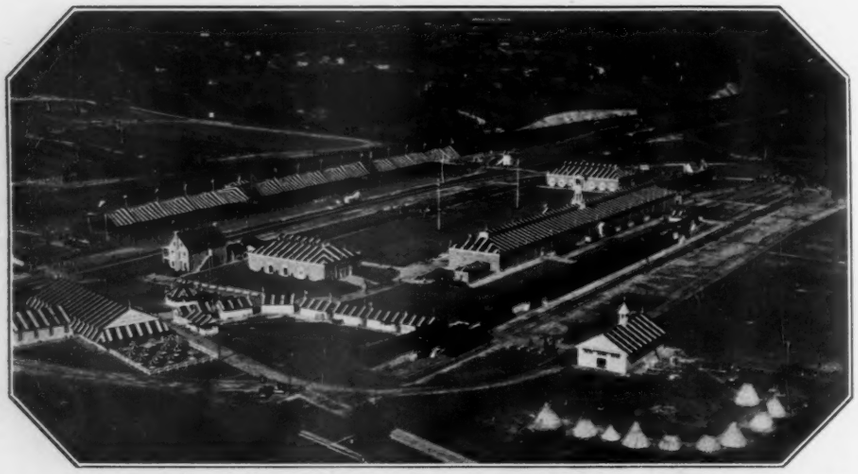
Right—This giant 329-ton locomotive is used now by the Baltimore & Ohio Railroad for heavy passenger traffic on mountain grades. Compare this modern monster with the 3½-ton "York"—the first locomotive in actual service on the line.



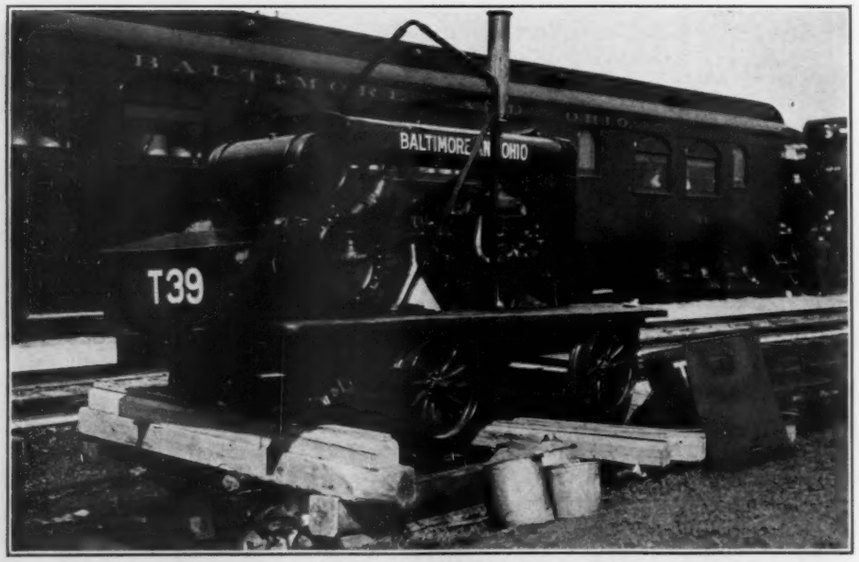
1—A working reproduction of Peter Cooper's "Tom Thumb," of 1829, drawing a passenger wagon such as was first used on the Baltimore & Ohio Railroad. The "Tom Thumb" weighed only 2 tons.
2—The "York," in 1831, was the first steam locomotive to be put in regular service on that line. It was built by Phineas Davis and weighed 3½ tons. It won a prize of $4,000 offered by the Baltimore & Ohio for the best steam locomotive.
3—This is the veritable "Atlantic," built in 1832, drawing reproductions of passenger coaches made for the Baltimore & Ohio in 1831. The "Atlantic" weighed 6½ tons.
4—The "Thomas Jefferson" was constructed in 1835; and just as we see it here it was used in Virginia for years—being the first locomotive to operate in that state.
5—The "William Galloway" is an exact reproduction of the "Lafayette" built in 1837 by Richard Norris of Philadelphia. It was the first locomotive with a horizontal boiler used on the Baltimore & Ohio.



Mallet type of articulated locomotive capable of exerting a tractive effort of 118,800 pounds and designed for heavy freight service.



Airplane view of the exhibition grounds at Halethorpe, Md. The site is part of a picturesque tract of 1,000 acres lying adjacent to the main-line tracks of the Baltimore & Ohio Railroad, a few miles outside of Baltimore.



Type of portable compressor now used by the Baltimore & Ohio Railroad to furnish air for operating pneumatic tie tampers and other tools employed in the upkeep of the roadbed.

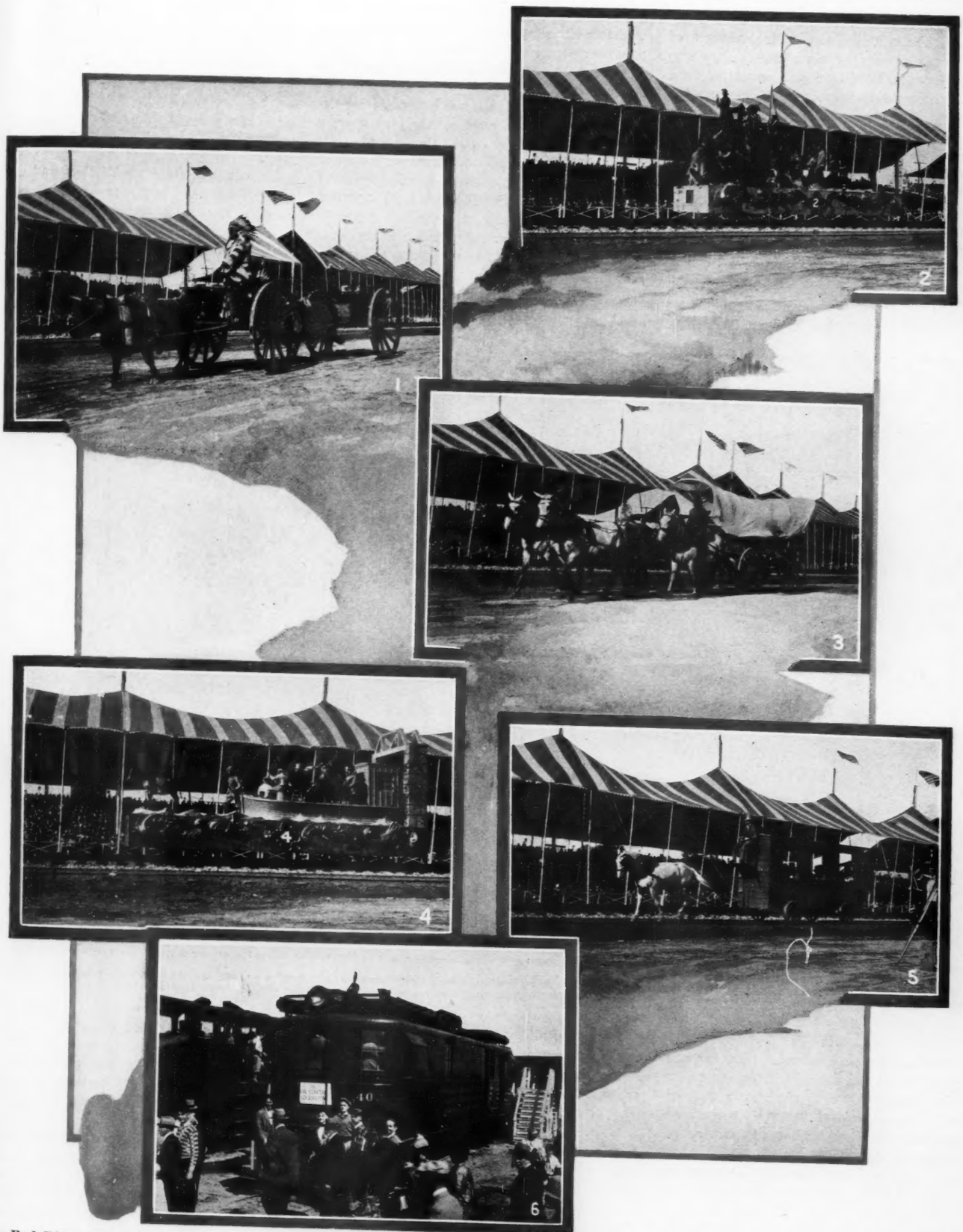
Ohio Railroad. In its conception, the Baltimore & Ohio represented an undertaking of unexampled extent and boldness of design. Its purpose was to insure merchandise from Baltimore reaching the region of the Ohio River seasonably—that is, with all practicable dispatch.

To this end, George Brown, a prominent figure in financial circles in Baltimore, called a meeting at his home on February 12, 1827. Twenty-odd of his fellow-citizens of prominency duly discussed the situation; and their unanimous opinion was that Baltimore could hold its own and even attain greater commercial importance only by building a railroad that should extend westward a distance of 300 miles to the Ohio River. As an outcome of that conference, the Baltimore & Ohio Railroad became a legal entity by a charter granted sixteen days later.

The problem of the promoters of that historic project was manysided and difficult, despite the fact that the people of Baltimore within a few weeks enthusiastically subscribed for more than $4,000,000 of the company's stock. To begin with, there was the route to be surveyed, decided upon, and graded, so that horses could do most of the hauling. Iron had to be imported for the rails; and few in this country, at that time, had any more than a reading knowledge of railroad practice as then developed in England, the "Mother of Railways." The pioneers here had virtually everything to learn; and, naturally, progress at the start was slow and halting.

Notwithstanding that the first stone—representing the beginning of construction work on the Baltimore & Ohio—was laid in the outskirts of Baltimore on July 4, 1828, and that the occasion was made much of by a street parade and fireworks, still it was not until 1830 that that railroad was ready to do business as a common carrier. Early in 1830, the road had a double-track line finished from Baltimore westward to Ellicott's Mills, 14 miles distant. By May 24, after much experimenting, cars had been built and equipped with flanged wheels, and horses had been secured to provide the needful motive power. On that day regular trains began running between the two terminals. The novelty of the service, as well as its promise, won instant favor; and within twenty weeks a regular schedule was adopted—the revenue from the carriage of passengers alone totaling as much as $1,000 a week, so it is recorded. The prevailing measure of enthusiasm and confidence can be judged from an extract from a letter written in 1830 by one of the financiers. He wrote: "We are perfectly satisfied that if railroads are properly made, they will supersede canals entirely in this country both for heavy and light traffic." This optimism served to tide over some years of disappointment and hard knocks before any of the railroads began to place the canals at a disadvantage.

While "locomotive engines," capable of reducing operating expenses by 30 per cent., were considered in England as early as 1829, still it was not until 1831 that the steam locomotive



1—Red River carts, drawn by bullocks, were one of the earliest forms of transportation through the country dominated by the Indians.
2—Float typifying the days when Pere Marquette and the pioneering white man penetrated the wilderness of America.
3—The Conestoga wagon was long the principal means of hauling freight over the first of America's highways.
4—Float representing that period of water transportation in which canals played a primary part in the social and industrial development of the country.
5—The horse of flesh and bone and blood did the hauling on the Baltimore & Ohio Railroad during the first years of that enterprising trunk line.
6—The Oil-Electric Locomotive is the latest engineering effort to solve the problem of economical transportation on our railroads.

became an accepted prime mover on the Baltimore & Ohio Railroad. In the autumn of 1829, Peter Cooper of New York City—who owned land in Baltimore and was, therefore, interested in the future of the town—gave the Doubting Thomases of the directorate of the road an object lesson. Having failed to convince those gentlemen that horses were not likely to prove satisfactory in hauling trains all the way from Baltimore to the Ohio River, the peppery gentleman of the Metropolis built a diminutive locomotive and sent its parts to Baltimore, where he reassembled them; and the *Tom Thumb,* for so the locomotive was called, was operated under its own steam on a stretch of track laid at Mount Clare, in the outskirts of Baltimore. Although the *Tom Thumb* was not entirely successful—it had mechanical shortcomings, its performances were so convincing that, in the end, the directors capitulated and were induced to advertise a competitive test—for a prize of $4,000—for the locomotive that would best meet the service requirements of the line.

In response to this, a number of locomotives were submitted for test during the summer of 1831. The *York,* built by Phineas Davis, of York, Pa., proved the winner, and was promptly purchased by the company and put to use on the road. The *York* weighed 3½ tons; and, after some modifications, was operated regularly between Baltimore and Ellicott's Mills—making two round trips each week day—hauling the *York Express.* It is said that the *York* was able to make the round trip of 28 miles in one hour's running time—an astonishing performance, so considered, for that period in American railroading.

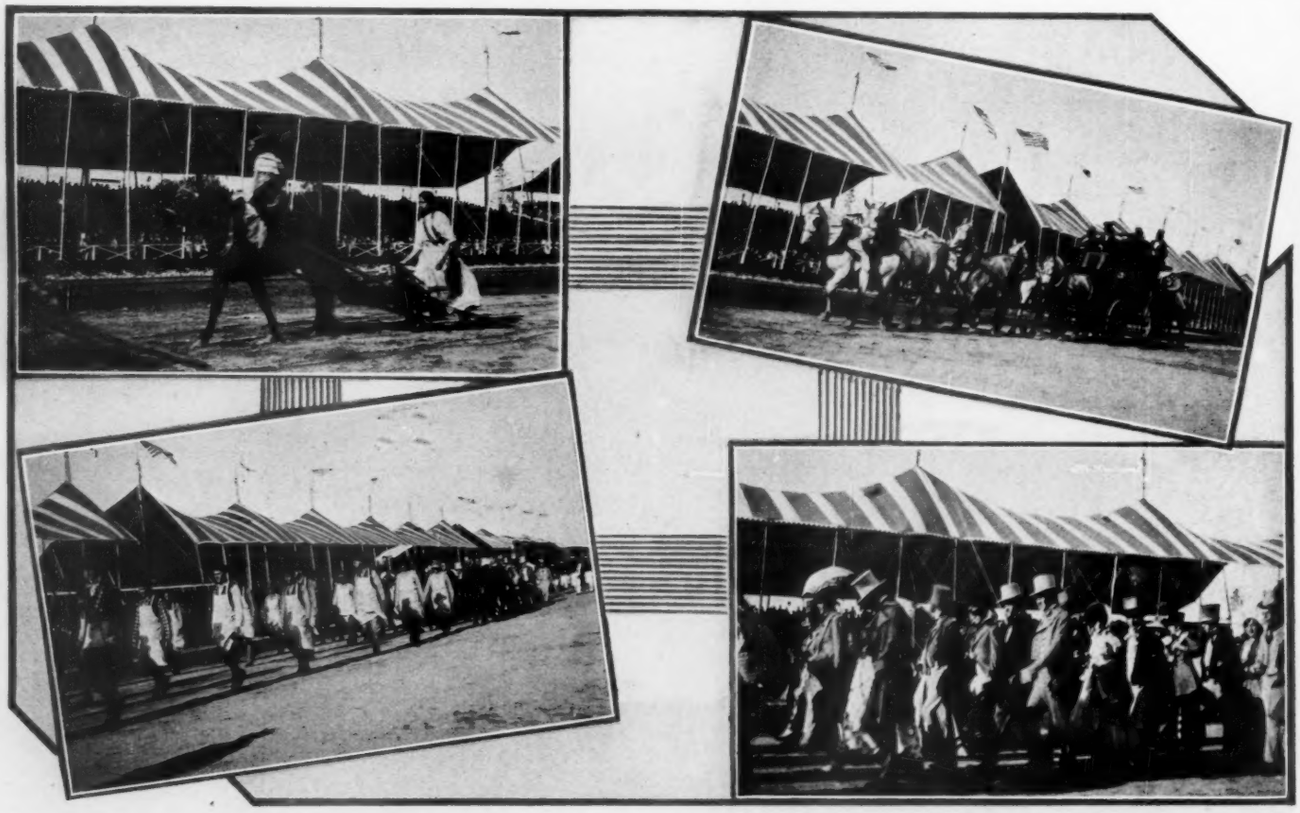
Having taken the first step in recognizing the superiority of steam traction, the Baltimore & Ohio was thereafter continually on the alert for any improvement in prime movers—calling into being almost immediately locomotive shops of its own at Mount Clare, Md. From that date on, the road took a prominent place in the art of building and developing steam locomotives—evincing in this enterprise the readiness to adopt the newest and best in railroad equipment. This policy the company has consistently adhered to ever since.

As a result of its own initiative and engineering skill, there was turned out from the Mount Clare shops in 1832 the locomotive *Atlantic,* which marked a decided advance upon the *York.* In quick succession there followed the *Traveller,* the *Arabian,* and the *Mercury*—each of which was an improvement upon its predecessors. Each of these locomotives, however, still held to the upright type of boiler; and it was not until 1837 that the *Lafayette* appeared upon the line with a horizontal boiler and in general form resembling the locomotive of today. Subsequently, no locomotives with vertical boilers were built for the Baltimore & Ohio Railroad.

By the end of 1834, the railroad had been extended westward as far as Harpers Ferry; but progress for some years thereafter was arrested because of the financial panic that then gripped the country. To make a long story short, the Baltimore & Ohio did not reach its contemplated goal, the Ohio River, until New Year's Day, 1853—nearly a quarter of a century after first breaking ground for the road.

By means of its extended lines and associate connections, the Baltimore & Ohio was able, in 1857, to provide service from the seaboard to Cincinnati and St. Louis. Running through some sections of the country alternately controlled by the Union and the Confederate contending forces during the Civil War, the road suffered by the conflict—its tracks being torn up time after time by the armies. As a consequence, that period of strife entailed enormous property losses to the railroad which, in the long run, played a conspicuous part in the cause of the Union throughout those years of warfare.

Immediately after the close of the Civil War, the Baltimore & Ohio brought other railroads into its system. During 1871 it extended its lines to Pittsburgh, and in 1874 it entered Chicago. In 1886, it built a connecting link which made it possible for the road to reach the Port of New York. Step by step, the system was expanded, and wider sections of the country and millions more people were served. To do this effectively and satisfac-



Top, left—The way the Indians used to move their belongings. Right—For a goodly while the stagecoach was the most rapid means of overland transportation.
Bottom, left—Part of the pageant picturing the craftsmen that made the Baltimore & Ohio possible at the start. Right—Participants in the pageant garbed in the dress prevailing in the early days of the Baltimore & Ohio Railroad.

torily, the management never hesitated to adopt any equipment that would make primarily for better service and ultimately for operating economy.

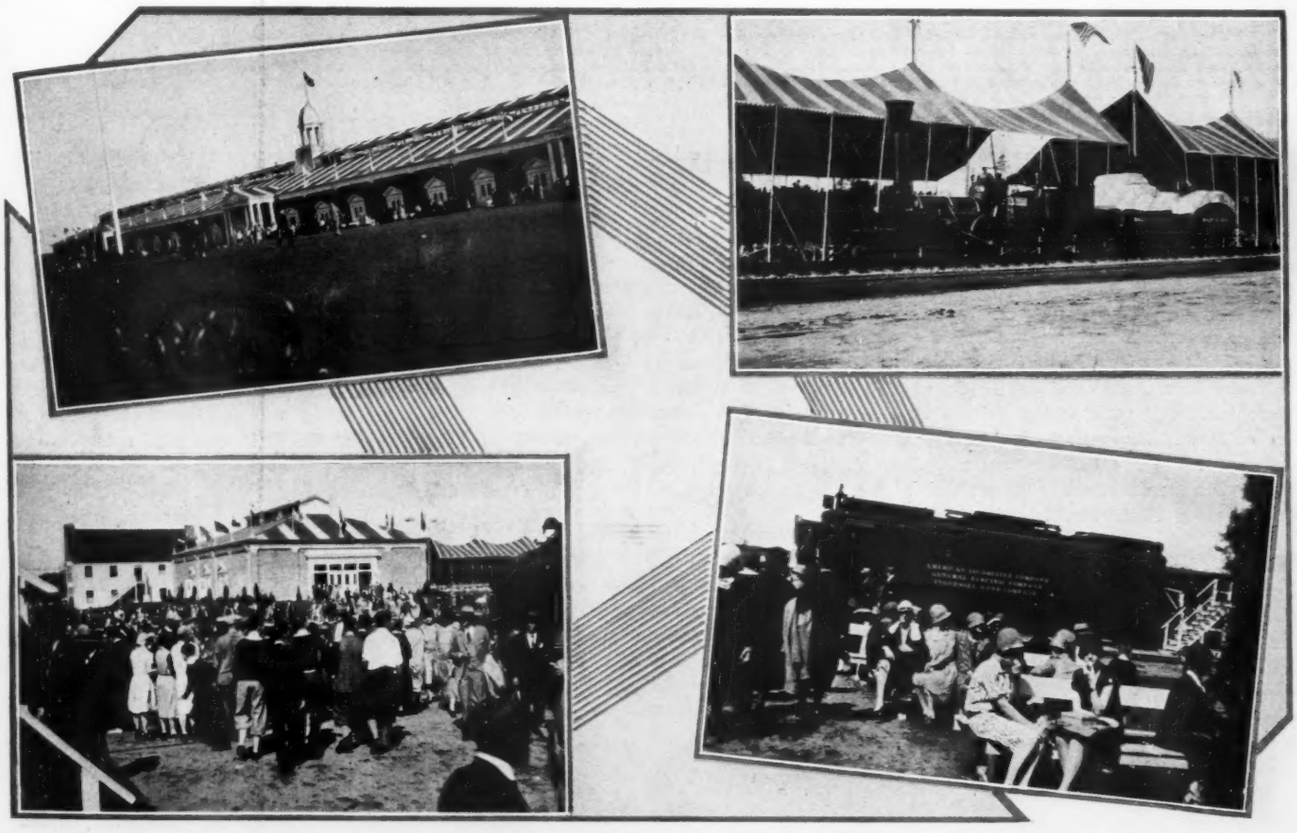
It is worth while here to recall that the line, in 1895, purchased the first electric locomotive put to work on a steam railroad. This form of smokeless and gasless traction was resorted to to pull trains, bound to and from New York, through the new tunnels in Baltimore. This employment of the electric locomotive marked a radical departure in railroad practice, and justly aroused engineering interest the world over.

The same keen pursuit of the better means has, in the last two years, led the Baltimore & Ohio to purchase several oil-electric locomotives; and these prime movers now serve in an important department of the railroad's field of operation. The oil-electric locomotive represents the very latest thing in locomotives, combining, as it does, the oil engine's efficient and economical use of fuel as well as the tractive advantages and the flexibility of control of electric drive. A locomotive of this kind attracted a great deal of attention at Halethorpe, where the road had on display one of its 100-ton type.

Some idea of how the Baltimore & Ohio has gone steadily forward, in accord with the company's policy of always keeping the road in the forefront of American trunk-line systems, can be gathered from the fact that during the past sixteen years more than $400,000,000 has been spent in the acquisition and rebuilding of lines and in the construction of bridges, locomotives, cars, and other necessary physical appurtenances.

We are authoritatively informed that: "Within twenty years virtually a new road has been created. Not alone physically. The Baltimore & Ohio has also a pride in the quality of its service. It operates, for instance, two of the finest of American trains—the *Capitol Limited* and the *National Limited*. The basis of the reputation of these trains is not so much upon their swiftness as upon their comfort and dependability."

With this splendid background of growth and of unceasing improvement in its function as a servant to the public over a period of 100 years, it is not hard to understand why Mr. Daniel Willard, the present president of the road, felt that a centenary exhibition was the only way in which this record could be fittingly celebrated and the romance of American railroading, in particular, brought home to the people for whom our far-flung network of lines has been developed. Nothing quite the same has been staged heretofore, nor presented in so picturesque and so convincing a manner. The Baltimore & Ohio Railroad is certainly to be congratulated.



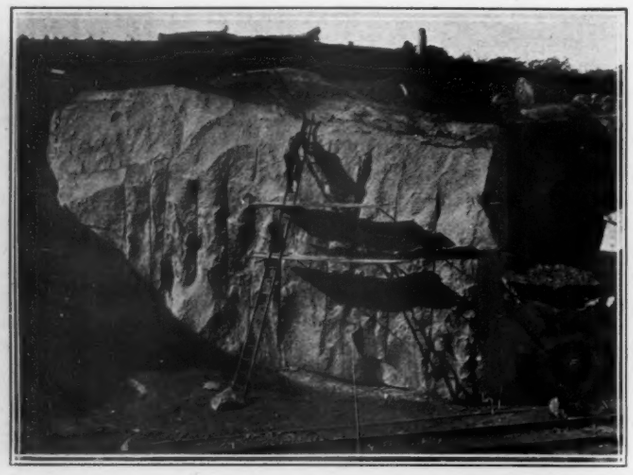
Top, left—Hall of Transportation in which were displayed designs and models illustrating the conception and the development of the locomotive over a period of nearly two and a half centuries. Right—Reproduction of the locomotive "Lafayette," built in 1837, which was the first engine with a horizontal boiler to be used by the Baltimore & Ohio Railroad.
Bottom, left—The Traffic Building contained many interesting aspects of passenger and freight transportation—the evolution of the modern trunk from the carpetbag being among the most informative. Right—The Oil-Electric Locomotive, the latest and most economical form of prime mover, rightly attracted much attention at Halethorpe.

PONTCHARTRAIN BRIDGE IS NEARING COMPLETION

WITH the opening in February of the great Pontchartrain Bridge near New Orleans, La., that city will at last have the long-desired outlet to the north and to the east. In other words, the bridge will be the means of linking New Orleans with two important transcontinental trunk routes—the old Spanish Trail from St. Augustine, Fla., to San Diego, Calif., and the New Colonial Highway from New Orleans to New York City. This last-named highway has a length of 1,535 miles, and is also to be dedicated to traffic in February.

The structure, which is said to be the longest concrete highway bridge in the world, is 14½ miles long, 35 feet wide, and will accommodate three lines of traffic. It has been provided with two bascule drawbridges; and has been built 5 feet above the highest storm-water level ever recorded for Lake Pontchartrain. It has been estimated that 625,000 cars will use this toll bridge the first year.

Venezuela now ranks fourth among the world's oil producers, being surpassed only by the United States, Russia, and Mexico. If developments continue as they have in the past, it is predicted that this comparative newcomer in the field will soon equal if not outstrip Mexico.



Courtesy, Sydney Morning Herald.

These pictures were taken in the granite quarry of the Dorman, Long & Company at Moruya, New South Wales. This firm is building the new Sydney Harbor bridge. At the left is a huge block of granite, weighing 2,000 tons. It is 55 feet long, 27 feet high, and has an average thickness of 18 feet. On the right is seen a massive piece of cut granite that will serve as the altar stone for the Sailors, Soldiers and Nurses Memorial in Martin-Place, Sydney.

BANK VAULT DEMOLISHED AFTER LONG FIGHT

A VERITABLE fortress was recently leveled in the heart of New York City's financial district. And while the attack was under the auspices of peace and progress rather than of war and retrogression, the stubbornness with which the efforts were resisted caused the undertaking to take on the aspects of a siege.

The battle in this instance had to do with the demolition of a vault within the old Mechanics & Metals National Bank Building at 20 Nassau Street. The building was razed to make way for the construction on the site of the new 38-story Chase National Bank Building.

While not of ultra-modern construction, the vault was designed to be burglar-proof and mob-proof, and it so well lived up to these specifications that three months of work were required to destroy it. Throughout this period a wrecking crew of fifteen men brought into play the most effective agencies at their command to reduce to ruins the mass of reinforced concrete, iron bars, and steel plates that made up the stronghold.

The vault was of the type known as a composite safe. It was two stories in height. Its thick walls were of reinforced concrete. Protecting them on the outside were plates of nonburnable metal, anchored with bolts. On the inside the walls were lined with half-inch finish-plates of chrome steel. The two circular doors which formed the only means of entrance and exit were of solid metal, 30 inches thick, and weighed 34 tons each.

These doors were removed in three weeks, after which the roof was attacked. It defied the workers four weeks before it was dislodged. This accomplished, the walls were forced apart by internal pressure applied by two 2,500-ton hydraulic jacks.

During the course of the work, oxy-acetylene torches, crow bars, blasting powder, and the most powerful pneumatic tools available were called upon to cope with the refractory materials. Compressed air from Ingersoll-Rand portable compressors operated the CC-35 paving breakers used to cut and rend the concrete from the steelwork. Sturdy, hard-hitting "Jackhamers" of the DCR-23 type drilled the holes which gave charges of dynamite footholds for their disruptive work. The demolition was started by the Albert A. Vogt Company, which later enlisted the aid of the Foundation Company.

As the difficulties encountered in removing the vault tended to illustrate in a graphic fashion the security which such depositories offer to safe-deposit patrons, the Chase National Bank issued an attractive, illustrated booklet, *The Siege of 20 Nassau Street*, in which the story of the work is set forth.

Attacking the concrete floor of the vault with CC-35 paving breakers.

COPPER DEPOSITED BY BACTERIA

IN a bulletin on *Organic Precipitation of Metallic Copper*, written by T. S. Lovering and published by the United States Geological Survey, the interesting fact is disclosed that metallic copper may be deposited in relatively small quantities through the action of bacteria. This discovery was made as the result of experiments with spongy masses of native copper found by members of the Geological Survey in the black muck of a bog near Cooke, Mont.

According to the *Mining Review*, several bodies of pyritic-copper ore crop out about half a mile above the bog. This ore weathers rapidly, and the copper is removed from it in solution as cupric sulphate. Redeposition of the copper as native metal only in the black muck and in none of the gravels and sands in the vicinity was ample proof that something in the muck had caused the precipitation of metallic copper from the sulphate solution; but the identity of the precipitating agent remained to be determined. Consideration of inorganic processes was discouraging, but preliminary experiments with the copper-bearing muck led to more carefully controlled experiments which proved beyond question that the copper was precipitated through the agency of certain bacilli.

Suction disks are being successfully used abroad for lifting non-magnetic materials such as glass, brass, copper, aluminum, etc. The load is gripped by a number of concave suction disks, the rims of which are provided with a suitable packing. These disks are placed on the plate to be raised; the air within them is partly exhausted; and atmospheric pressure is made use of to create an adhesion sufficient to bear the pull of the weight of the material.

Oil-Electric Locomotive Shows Fitness for Passenger Service

THE oil-electric locomotive has ceased to be a novelty in terminal yards for handling freight cars—in making up or breaking up trains. The oil-electric locomotive has also proved especially effective in the logging industry, and is doing excellent work in the field of mining where heavily laden strings of cars are moved from point to point. Only recently, however, has the oil-electric locomotive demonstrated its capabilities for passenger service. The test that revealed its fitness for this work consisted of a run of 183.7 miles on the Erie Railroad from Hornell, N. Y., to Meadville, Pa.

The performance was of such outstanding success that the results will inevitably arouse widespread interest among railroadmen when the details of that run become generally known. The present-day railroadman is, of necessity, keenly on the alert for the most economical form of prime mover.

The oil-electric locomotive that made the trip from Hornell to Meadville was one recently acquired by the Erie Railroad and destined for switching service in the Akron, Ohio, yards of that line. It is one of two 100-ton locomotives of this type purchased by the road for that purpose, and differed from its companion unit only in being geared for high speed. That is to say, a temporarily interposed gearing made it possible for this particular locomotive—known as *No. 22,* to travel faster on the power primarily developed by its two oil engines.

The two engines of this oil-electric locomotive develop 600 hp.; and it may help us to a better understanding of what it accomplished if we bear in mind that *No. 22* has only one-quarter as much power as the steam locomotive used by the Erie Railroad to make its fastest passenger run between Hornell and Meadville. The test train was made up of four cars—that is, the train was about one-third as heavy as the regular train on the run in question. In other words, the load on the oil-electric locomotive, per unit of power, was greater than is ordinarily the case with the scheduled train.

The run from Hornell to Meadville took 5 hours and 30 minutes—the train making the while six stops each of three minutes' duration; and it was obliged to slow down on numerous occasions because of section gangs and construction work on new bridges. The fuel consumed during the journey represented a train-cost averaging only 3.65 cents a mile!

Aside from the remarkable fuel economy just mentioned, the other outstanding feature of the trip was the quickness with which the steam-locomotive engineers mastered the control essentials of the oil-electric locomotive, with which they had had no previous acquaintance. The first engineer on the available list was assigned to the oil-electric locomotive. He was M. H. Coville. When he entered the cab he was merely told: "This is your throttle; this is your reverse lever; and this is your air-brake control. Now, go to it." Within three minutes Engineer Coville had the train underway. At Salamanca—the relief point—the second engineer, L. C. Rhodes, stepped aboard. His instructions were virtually a duplication of those given the man he was relieving. Even so, Mr. Rhodes lost no time in getting his train in motion; and, as a consequence of the work of the two engineers, the oil-electric locomotive kept to the schedule prescribed for the steam locomotive on the same run.

The excellent performance of oil-electric locomotive *No. 22* on the test trip from Hornell to Meadville is convincing evidence that locomotives of this particular type can be readily adapted to passenger service by fitting them with suitable gearing—the structural get-up of the units being otherwise like those designed in the first place for switching or freight work. Manifestly, that performance has also shown that the oil-electric locomotive has a much wider field of usefulness than that in which it has heretofore been employed. There is every reason to believe that oil-electric locomotives, geared in a similar manner, will be used in passenger service and, at the start, on branch lines where the need of operating economy is most pressing at the present time owing to the relatively reduced volume of traffic and to the competition of other forms of overland transportation.

TELEGRAPH WIRES SAID TO GIVE STORM WARNING

IF what a Paris scientist claims is true, it will be possible for us to foretell the coming of a storm by the singing of telephone or telegraph wires. While attempting to ascertain the cause of the singing of such wires, he discovered, so it is said, that the vibration of the wires always presaged the approach of bad weather. According to this investigator, a change of weather may be looked for within two days when the sound emitted by them is deep. But, if the sound is shrill—of a high pitch—then it is a warning that a storm may be expected in a few hours.

Paradoxically, telephone wires are sometimes silent when the wind is blowing hard and sonorous in times of calm. Just why this should be so seems to be a difficult problem to fathom; but it appears evident that the vibration of the wires is not entirely due to atmospheric disturbances. An American scientist calls it seismic agitation produced by barometric depression and transmitted to the wires by telephone and telegraph poles.

Oil-electric locomotive, drawing a passenger train, arriving at Meadville, Pa., on schedule time after a run of 183.7 miles.

Carving a Great Memorial on the Rocky Face of Rushmore Mountain

THE people of South Dakota have taken the lead in creating a gigantic memorial in the heart of the Black Hills. Gutzon Borglum, the well-known sculptor, has been commissioned to carve on Rushmore Mountain the features of George Washington, Thomas Jefferson, Abraham Lincoln, and Theodore Roosevelt. The figures will be scaled to the titanic proportions of men 465 feet high. Work on this great undertaking has been started; and rock drills, driven by compressed air, have already begun the transformation which will give to the age-old face of Rushmore the enduring lineaments of four of our erstwhile presidents.

Probably, the best way to describe the purpose and the spirit of this project would be to quote, in part, from the address made by President Coolidge at the dedicatory exercises held during the past summer upon a secondary mountain directly below Rushmore Rock. On that occasion, the President said:

"We have come here to dedicate a cornerstone that was laid by the hand of the Almighty. On this towering wall of Rushmore, in the heart of the Black Hills, is to be inscribed a memorial which will represent some of the outstanding events of American history by portraying with suitable inscription the features of four of our presidents, laid on by the hand of a great artist in sculpture. This memorial will crown the height of land between the Rocky Mountains and the Atlantic seaboard, where coming generations may view it for all time.

"It is but natural that such a design should begin with George Washington, for with him begins that which is truly characteristic of America. He represents our independence, our constitution, our liberty. He formed the highest aspirations, that were entertained by any people, into the permanent institutions of our government. He stands as the foremost disciple of ordered liberty—a statesman with an inspired vision who is not outranked by any mortal greatness.

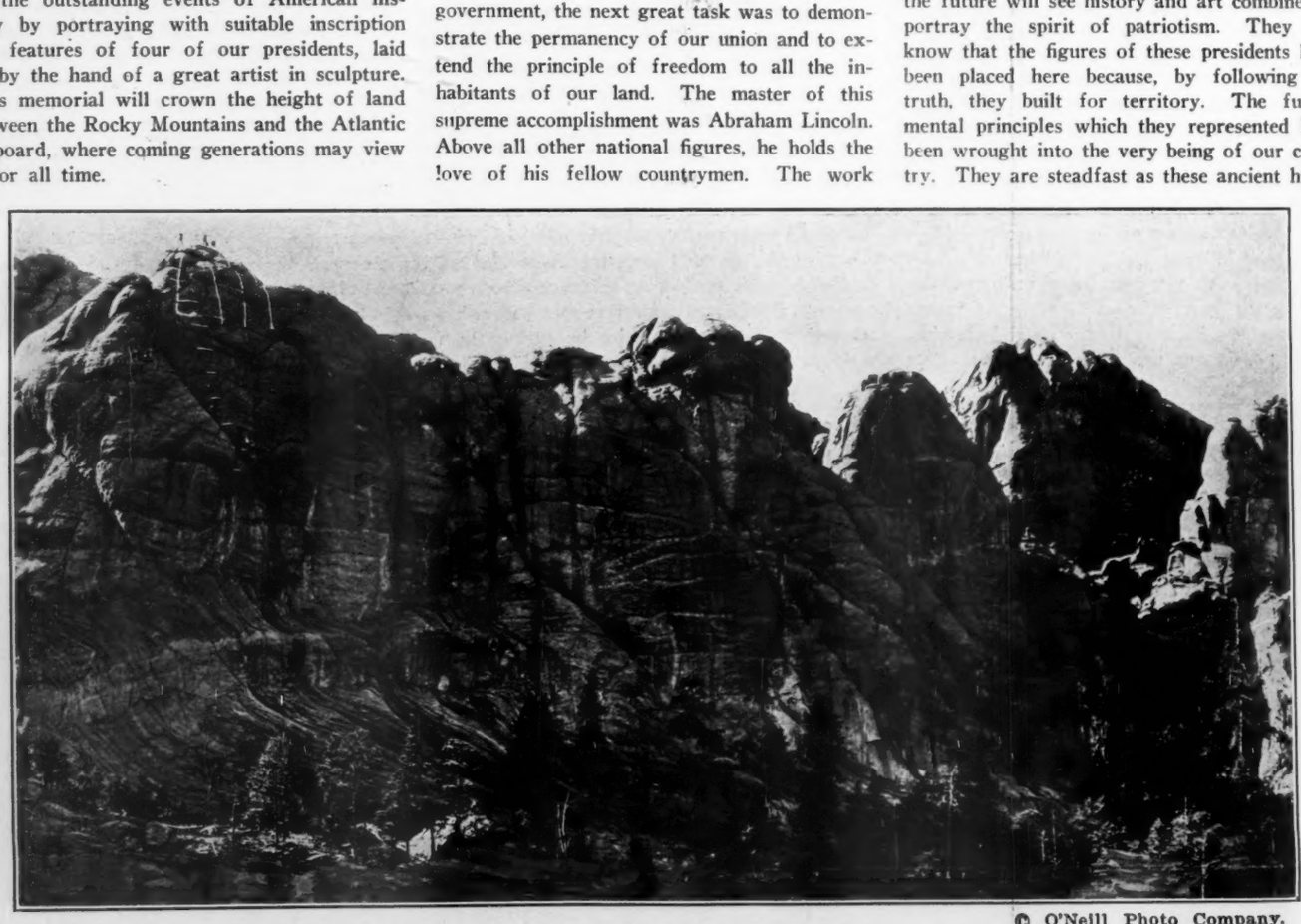
"Next to him will come Thomas Jefferson, whose wisdom insured that the government which Washington had formed should be intrusted to the administration of the people. He emphasized the element of self-government which had been enshrined in American institutions in such a way to demonstrate that it was practical and would be permanent. In him, likewise, was embodied the spirit of expansion. Recognizing the destiny of his country, he added to its territory. By removing the possibility of any powerful opposition from another neighboring state, he gave new guarantees to the rule of the people.

"After our country had been established—enlarged from sea to sea and dedicated to popular government, the next great task was to demonstrate the permanency of our union and to extend the principle of freedom to all the inhabitants of our land. The master of this supreme accomplishment was Abraham Lincoln. Above all other national figures, he holds the love of his fellow countrymen. The work which Washington and Jefferson began, he extended to its logical conclusion.

"That the principles for which these three men stood might be still more firmly established, destiny raised up Theodore Roosevelt. To political freedom, he strove to add economic freedom. By building the Panama Canal he brought into closer relationship the east and west and realized the vision that inspired Columbus in his search for a new passage to the Orient.

"The union of these four presidents, carved on the face of the everlasting hills of South Dakota, will constitute a distinctly national monument. It will be decidedly American in its conception, in its magnitude, in its meaning, and altogether worthy of our country. No one can look upon it understandingly without realizing it is a picture of hope fulfilled.

"Its location will be significant. Here in the heart of the continent—on the side of a mountain which probably no white man had ever beheld in the days of Washington, in territory which was acquired by the action of Jefferson, which remained an almost unbroken wilderness beyond the days of Lincoln, which was especially beloved by Roosevelt, the people of the future will see history and art combined to portray the spirit of patriotism. They will know that the figures of these presidents have been placed here because, by following the truth, they built for territory. The fundamental principles which they represented have been wrought into the very being of our country. They are steadfast as these ancient hills."



High at the left, on the face of the rock of Rushmore Mountain, Gutzon Borglum is now at work carving an enduring memorial to four of our historic presidents.

Making Ammonia From Two Common Gaseous Elements

Six-stage Compressors Put Nitrogen and Hydrogen Under 4,500 Pounds Pressure to Induce Combination

By C. H. VIVIAN

THE alchemists of old who sought, without startling success, to introduce legerdemain in the laboratory, would have reveled in a journey through a synthetic anhydrous-ammonia plant. Skilled pretenders though they were, they no doubt would have stood aghast had they been privileged to see two colorless, odorless gases transformed within the confines of a single room into a liquid yielding fumes of biting pungency.

The office and a part of one plant of the Mathieson Alkali Works at Niagara Falls.

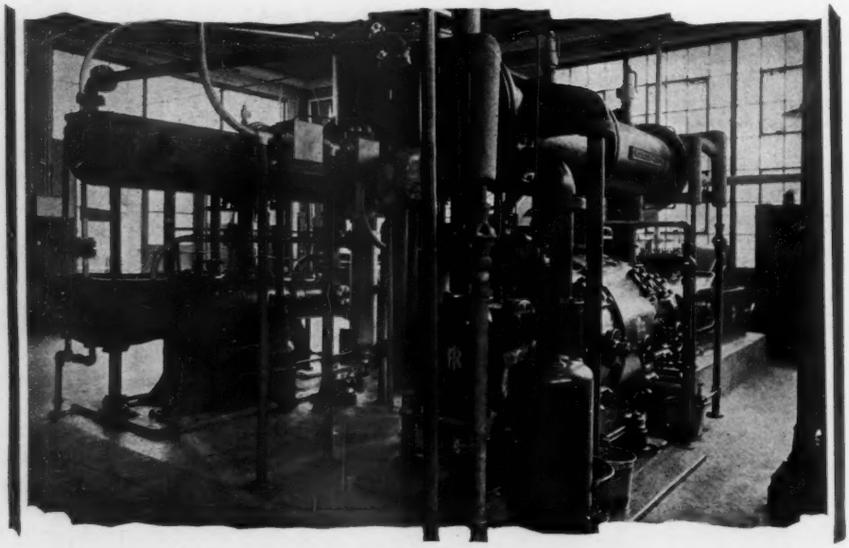
Virtually all the anhydrous ammonia used today is made synthetically—that is, by direct chemical combination of one part of nitrogen with three parts of hydrogen. The method has superseded the distillation of coke-oven and gas-plant liquors; and has given the ice industry, oil refineries, and other major users a purer product at a price reduced by more than half.

Laboratory experimentation proved many years ago that the constitutent gases of ammonia would combine under certain conditions. However, Nature had imposed a restriction, such as the canny Scot foresaw when he headed his recipe for rabbit *en casserole* with the admonition, "First, catch the rabbit." In this instance, the rabbit was the nitrogen. It was very plentiful, but distressingly elusive.

Nitrogen exists in a free state in some natural waters and in combination in the form of Chile saltpeter and other ammonium salts. Likewise, it is present in all soils where compounds are formed by nitrifying bacteria. Moreover, it forms approximately 79 per cent. of the weight and approximately 77 per cent. of the volume of the atmosphere. Despite its widespread distribution, however, no commercially feasible method of isolating it and "fixing" it, or combining it in a stable, usable form, was devised until a few years ago.

The extraction of nitrogen from the air has been the goal of scientists in various parts of the world for several decades. Birkeland and Eyde were the first to accomplish it on a quantity basis. Having determined that during thunder storms lightning dissociates the nitrogen and oxygen in the air, they set about to duplicate the phenomenon. They used a 5,000-volt electric arc, which created a temperature of 5,432°F. They were able to secure nitric oxide, which, on being cooled with residual gases, formed nitrogen peroxide. By leading the gas into towers through which streams of water descended, they formed a weak solution of nitric acid, which was later concentrated. This, however, was an expensive process and out of the question as a commercial proposition except where extremely low-priced electric power was available in large quantities. German scientists pioneered the commercial extraction of atmospheric nitrogen as it is practiced today; and it is due almost entirely to that fact that Germany was able to prolong her participation in the World War as long as she did.

Niagara's majestic sweep, as viewed from Goat Island, which divides the American Falls, shown on the left, from the Canadian Falls, at the right. The availability of abundant inexpensive power has been a leading factor in making the City of Niagara Falls an important center for electro-chemical manufacturing industries.



A rear-end view of one of the PRE-6 compressors, which were built to order by the Ingersoll-Rand Company to perform an important function in the manufacture of anhydrous ammonia.

Nitrogen, in the form of nitrates, is essential to the manufacture of high explosives. The Teutons, in common with other nations, had been deriving most of their supply of nitrates from deposits in South America. Before the war had been in progress many months, the allied navies had drawn a tight cordon around Germany's ports, and her fleet was rendered useless. But, despite the inability of her vessels to reach South America, and notwithstanding the fact that she was known to be without domestic deposits of nitrates, Germany showed no signs of curbing her artillery fire along the various war fronts. The explanation was that her physicists had discovered a practicable means for extracting and fixing atmospheric nitrogen. The initial German success led immediately to the development of similar processes in France, Italy, and in the United States. All these are now in use, and differ primarily in the variations of temperature and pressure at which the nitrogen and hydrogen are combined.

Designs of an American company were employed by the Federal Government during the war in the construction, at Sheffield, Ala., near Muscle Shoals, of a plant for the extraction of atmospheric nitrogen to be utilized in the making of munitions. The signing of the Armistice removed the need for that plant for the moment; and, except for a test run to prove its practicability, it has never functioned. Various overtures have been made by private capital to take it over for the manufacture of nitrates for fertilizers, but all have been rejected.

Meanwhile, various applications of the basic process have been made in the manufacture of anhydrous ammonia—a product of widespread use and ready salability. Several firms in the United States are engaged in that field of activity today. Prominent among them is the Mathieson Alkali Works, Inc., of New York, whose electrolytic plant is located at Niagara Falls, N. Y.

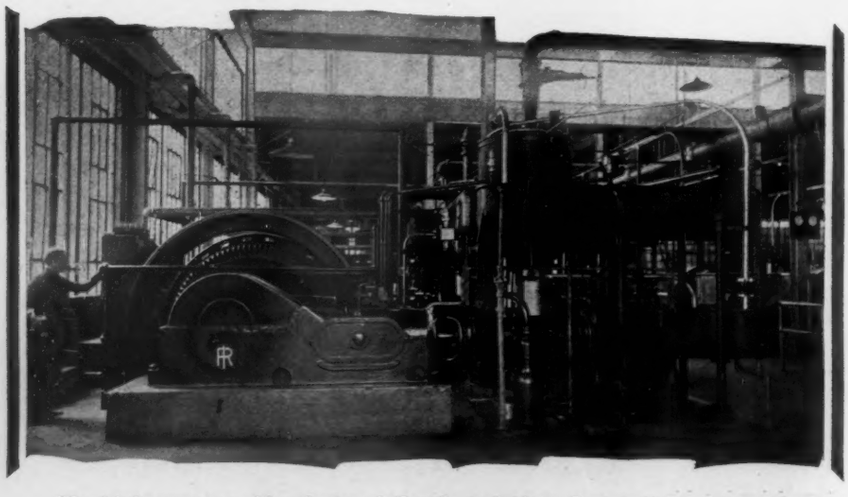
This company's principal business is the making of chlorine gas and caustic soda by the electrolytic decomposition of salt. A by-product of its plant is pure hydrogen. For more than 25 years this hydrogen was allowed to go unused. Now it is made to contribute to the production of a marketable industrial material. The anhydrous ammonia plant has been in successful operation for more than three years—its present daily capacity being 10 tons of anhydrous ammonia and, incidentally, a small quantity of aqua ammonia, or ammonium hydroxide.

The hydrogen is piped directly from electrolytic cells to a steel holder having a capacity of 100,000 cubic feet. Atmospheric air is drawn into the plant to supply the nitrogen. It is cleaned and purified by scrubbing and by passing it through chemicals that remove harmful materials. Streams of hydrogen and air are pumped into a burner. The air is there burned in an excess of hydrogen—approximately 2.8 cubic feet of hydrogen being introduced for each cubic foot of air. The flow is recorded by meters.

The product of this combustion is steam, plus a mixture of nitrogen and hydrogen in just the proper proportions for the formation of ammonia. The oxygen of the air and the excess of hydrogen combine to form the steam, which is condensed and drawn off as water. The nitrogen and hydrogen then pass into a steel holder having a capacity of 50,000 cubic feet. While their ratio to each other is that in which they are present in ammonia, still they will not unite at atmospheric pressure and, accordingly, it becomes necessary to compress them highly. Although the desired reaction will take place at various pressures, the engineers of the Mathieson Company consider 4,500 pounds to the square inch to be the most situable pressure.

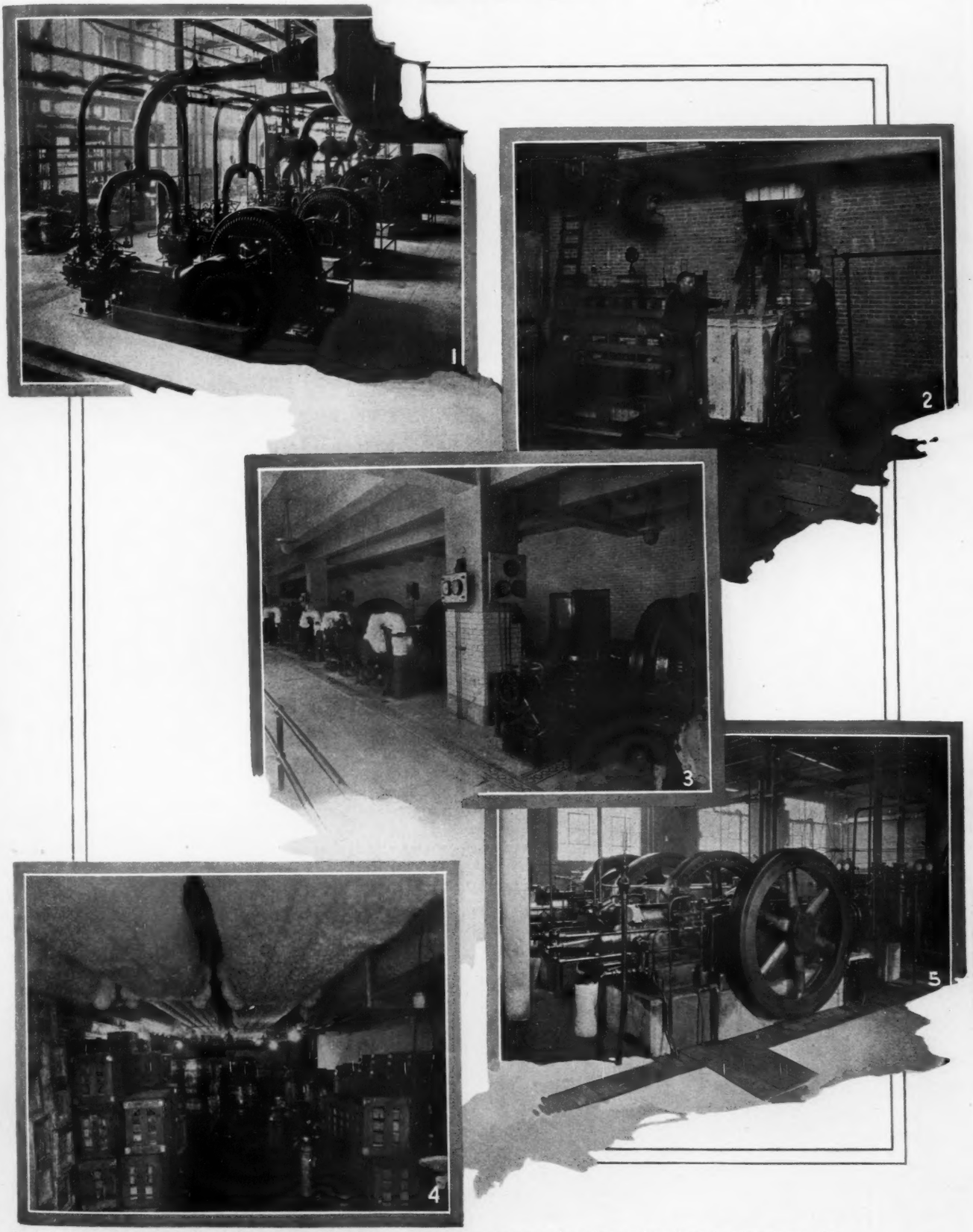
It can be readily realized that dependable compressors are all-important to the proper functioning of such a plant. Some idea of the work they are called upon to do may be had when it is considered that they must raise the pressure on the gas to 300 times that of atmospheric pressure. What their task is can, perhaps, be more fully appreciated when it is recalled that air under a pressure of 100 pounds to the square inch serves to operate drills that penetrate solid rock and concrete. The capacity to multiply such a pressure by 45 requires machines of extraordinary qualifications. The sort of compressors demanded could not be purchased as standard machines: they had to be designed and manufactured to order. The making of them was entrusted to the Ingersoll-Rand Company.

The compressors are of the 6-stage type, and embody the same principles of design as the company's PRE compressors. They bear the distinction of being the only 6-stage compressors ever built in the United States. They are of what is known as duplex construction—that is, the cylinders for the first three stages of compression are in line on one side and those for the last three stages are in line on the other side. Between them is the source of power, a General Electric Company direct-connected, 325-hp., synchronous motor.

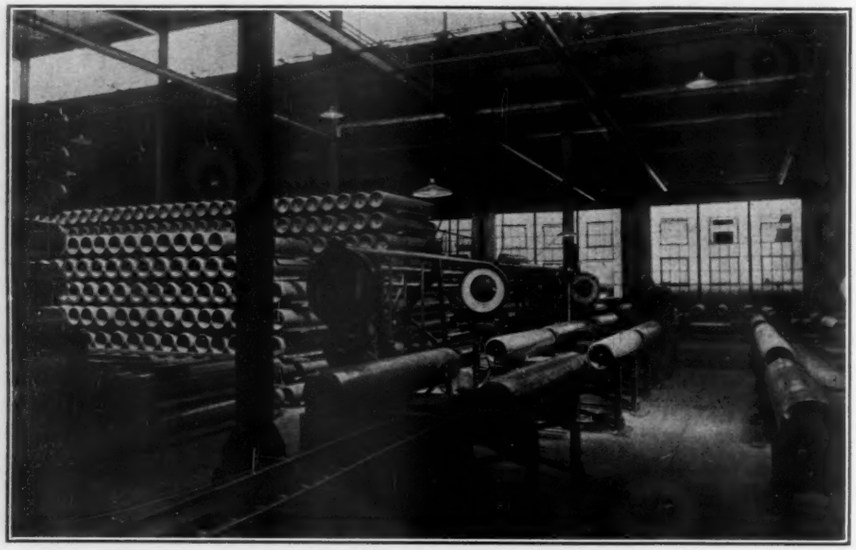


The high-pressure side of one of the three 6-stage Ingersoll-Rand compressors that deliver the mixed nitrogen and hydrogen gases to the converter under a pressure of 4,500 pounds to the square inch.

SOME ASPECTS OF THE REFRIGERATING INDUSTRY, WHICH IS THE LARGEST USER OF ANHYDROUS AMMONIA



1—A battery of electrically driven Ingersoll-Rand ammonia compressors in a large ice plant in New York City.
2—Filling cans with filtered and pre-cooled artesian water to be frozen into blocks of ice.
3—The compressor room in one of Philadelphia's large ice-cream plants.
4—Perishable foodstuffs of all sorts are kept in perfect condition in this cold-storage chamber at a railroad terminal in Philadelphia.
5—Two efficient oil-engine ammonia compressors of the POC-I-A type in a New Jersey ice and cold-storage plant.



The metal cylinders, in which the product reaches the trade, are here charged with anhydrous ammonia. During the filling, the containers rest on scales which show when the specified net weight of the contents has been reached.

When the machines are operating at full load, the gases are compressed in the successive stages to 21, 85, 315, 780, 1,900, and 4,500 pounds pressure. Between each stage, they pass through intercoolers and, after the final stage, through an aftercooler. Condensers are provided for the removal of water vapor and oil between the various stages. Three of these compressors are installed: two of them are operated at a time and the third is held for reserve service. As the plant works on a 24-hour basis for seven days a week the compressors are under heavy duty, but they have proved equal to the demands made upon them.

From the compressors, the gases flow through seamless steel tubing of heavy construction to high-pressure purifiers, where remaining traces of oil and water are removed from them. They then pass to the converter, where the actual formation of the ammonia takes place. This converter is a vertical cylinder, and its walls are constructed of chrome-vanadium steel 8½ inches thick. The weight of the shell alone is 65 tons.

The union of the gases takes place in the presence of a catalyst. The heating of the incoming mixture is effected, once the operation is started, by the heat of the outgoing product —the reaction proceeding exothermically at a temperature which is maintained at about 930°F. Continuous operation is desirable to maintain this temperature, and for that reason it is essential that all equipment and machinery be dependable in action.

Approximately 20 per cent. of the gases unite to form ammonia in the converter. This 20 per cent., in a gaseous state, together with the 80 per cent. of unconverted nitrogen and hydrogen, is then piped to a liquefier, where the liquefaction of the ammonia is accomplished by water cooling. In this cooler, the temperature is reduced to approximately 86°F. The liquid, or anhydrous ammonia resulting from the condensation is drawn from the liquefier into storage tanks, of which there are five. Interposed between the liquefier and the storage tanks are expansion valves which serve to reduce the pressure to that which corresponds to the 86-degree temperature.

The remaining 80 per cent. of the gases containing small amounts of uncondensed ammonia, after passing through the liquefier, is then directed through a circulating compressor and thence back into the line leading from the 4,500-pound compressors. The volume of gases admitted into the line from the high-pressure compressors is just sufficient to replace that which has been drawn off as converted ammonia.

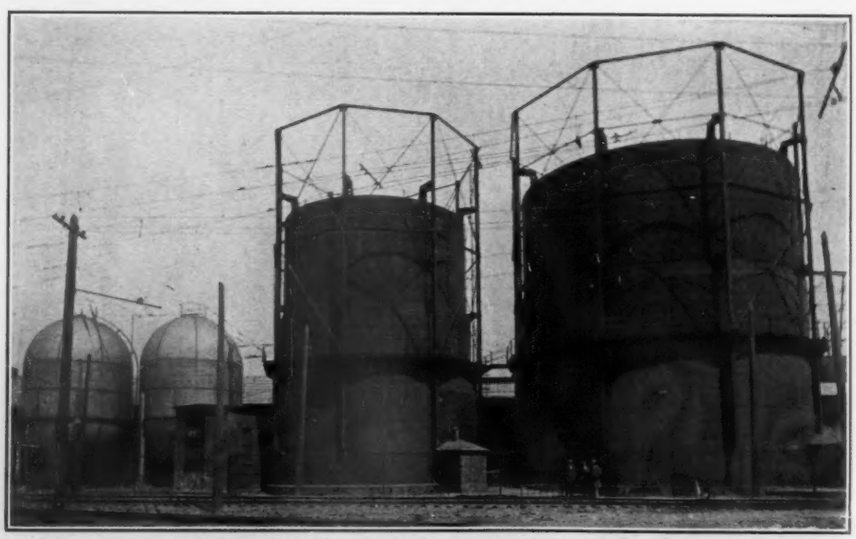
From this "make-up" point, as it is called, the route is back through the high-pressure purifiers and to the converter. The ultimate conversion obtained by repeated circulation closely approximates 100 per cent. of the gases compressed. A small proportion of the gaseous ammonia is withdrawn from the system and utilized in the making of aqua ammonia, which has a wide field of application and which, in diluted form, is the familiar product of household use.

From the storage tanks, the ammonia passes into the charging room, where it is put into the metal cylinders in which it is shipped. These cylinders are of three sizes, which have respective capacities of 50, 100, and 150 pounds, net weight. Eight points for filling are provided. The cylinders rest upon scales during the charging operation and, before delivery, are again weighed on check scales.

A sample of the contents of each cylinder is drawn off for two tests before the ammonia is approved for shipment. The first of these tests consists of evaporating 100 cubic centimeters of the ammonia to determine the moisture content. If the sample does not meet the rigid specifications imposed, the cylinder is rejected. While small amounts of water are not injurious to the proper functioning of ammonia in its various commercial applications, the demand of the trade is for a dry product, and no other is sold. The second test is for non-condensable gases. Here, again, failure of the sample to satisfy requirements results in the rejection of the cylinder.

The ice, the ice-cream, and the refrigeration industries are the major users of anhydrous ammonia. Other important fields of application for the product are chemical plants and oil refineries.

Note—The writer wishes to express his thanks to Mr. A. E. Hecker, superintendent of the ammonia plant of the Mathieson Alkali Works, Inc., to whom he is indebted for much of the material contained in this article.



Gas holders and storage tanks for anhydrous ammonia.

The United Railways & Electric Company of Baltimore, Md., has established a weather bureau for its personal use in that city. There it maintains a 24-hour service for the primary purpose of getting advance information of approaching snowstorms that might interfere with the operation of its lines. In this way the maintenance department is always forewarned, and therefore ready to cope with the situation the moment it arises.

Making Battery Jars and Carboys

Gayner Glass Works, In Salem, N. J., Has Been Conspicuous In the Industry For More Than Half a Century

By S. G. ROBERTS

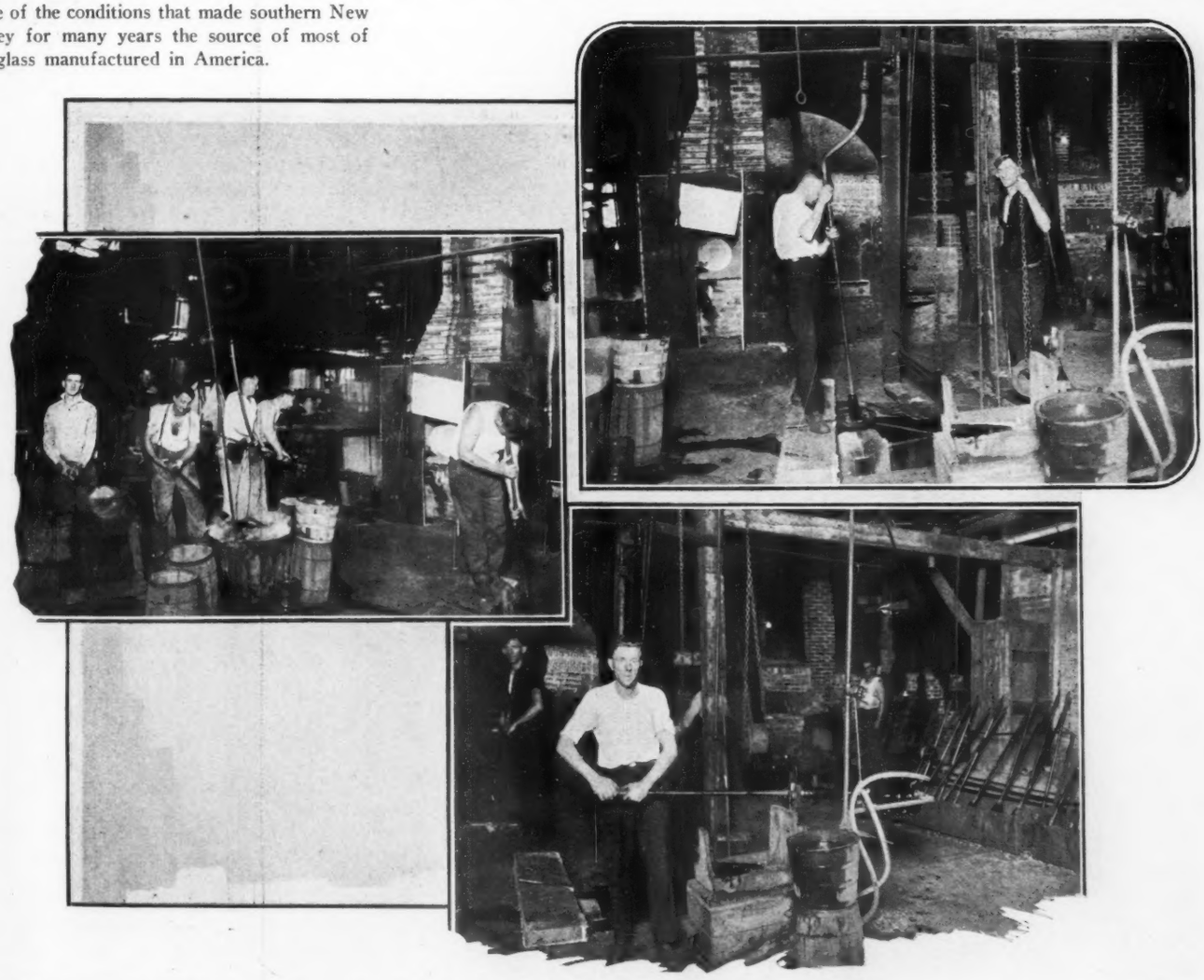
SALEM, N. J., enjoys the distinction of being among the oldest of the country's glass-manufacturing centers. Today, as was the case long ago, the glass industry still flourishes in this picturesque town that so pleasantly reflects the centuries that have passed since the community was instituted. The art of making glass in Salem has, therefore, been handed down from generation to generation—changing its applications as each succeeding period has found new uses for the material.

Bottles constituted a predominating percentage of the products in the decades past, and bottles loom very large in the volume of commodities now turned out in Salem's glass plants. But don't let us hasten: let us review some of the conditions that made southern New Jersey for many years the source of most of the glass manufactured in America.

As far back as 1675, John Fenwicke, an English Quaker, sailed in between the Capes of the Delaware River, disembarked on the shore of what we now call New Jersey, and purchased lands from the Indians. There, he called into being the first permanent English settlement on the Delaware, and named the place Salem. Twenty years later, Salem was formally incorporated as a town.

In those days, as long afterwards, glass beads were a medium of barter and exchange between the white man and the Indian; and beads and other forms of glassware had then to be imported from abroad. Accordingly, the early settlers of New Jersey—especially those dwelling near the seacoast, soon essayed to make glass, themselves, from the abundant raw materials at hand. In doing this, they followed the example set by the colonists at Jamestown, Va., who began the manufacture of glass as early as 1609.

One has only to recall that three essential materials are needed to produce one kind of glass—those are lime, sand, and soda ash or potash. The early settlers in New Jersey found sand of the required quality in or adjacent to the nearby beaches; and they got their lime by burning oyster or clam shells, gathered from the neighboring flats or water beds. For fuel, they had available seemingly inexhaustible



Left—Primary operations in the hand-blowing of large glass containers.
Top—Where compressed air instead of the operator's breath is used to expand the glass bubble, within the cast-iron mold, that forms the body of a 12-gallon container.
Bottom—At this stage the cooling action of compressed air is employed to solidify the plastic glass forming the body of a large container.

Left—Shoveling cullet or broken glass into one of the melting tanks. A certain proportion of cullet is used in the mix or melt from which bottles, carboys, etc., are blown.
Right—Putting finishing touches on a carboy before carrying it to the annealing furnace. The operator at the right is forming the lip on the neck of a container.

stands of pine timber; and from the ashes of this fuel, when leached, they obtained the potash they needed. Thus, because of trade demands and consideration of their own convenience and comfort, the pioneers in New Jersey brought into being a glass industry that has continued there, with varying degrees of importance, ever since.

Plainly, the Gayner Glass Works, in Salem, has a historical background for its activities. That enterprise is relatively young—dating back a little more than half a century. To be exact, the works was established in 1874 by John Gayner, Sr., who died only a few years ago at the very ripe age of 90-odd years. So absorbed was Mr. Gayner in the business that he had created that he visited the plant almost daily up to the time of his death—in the latter years being taken there in a wheel chair. The business is now directed by his son Edward J. Gayner, the president of the company.

The plant is engaged in the manufacture of what is known in the trade as "large ware," consisting principally of large bottles, carboys, battery jars, etc. In the course of its career, the Gayner Glass Works has relied upon different sources of primary power—steam, produced with coal, predominating for the most part. And in blowing or molding its ware, the plant for a long time depended upon the lungs of its workers; and only in recent years, so to speak, has the management found it advantageous to have recourse to compressed air for various purposes. Similarly, coal and gas have successively been utilized to provide heat for the melting tanks; and today compressed air and fuel oil are employed to heat molds and the small furnaces or "glory holes" in which the glass is reheated during different stages in the blowing and forming of the ware. These facts are mentioned so that the reader will realize that the Gayner Glass Works has, in its way, reflected the march of engineering in the generation of power and heat. The latest innovation at the plant has been the introduction of an oil-engine-compressor unit to furnish compressed air for numerous services throughout the different departments of the establishment.

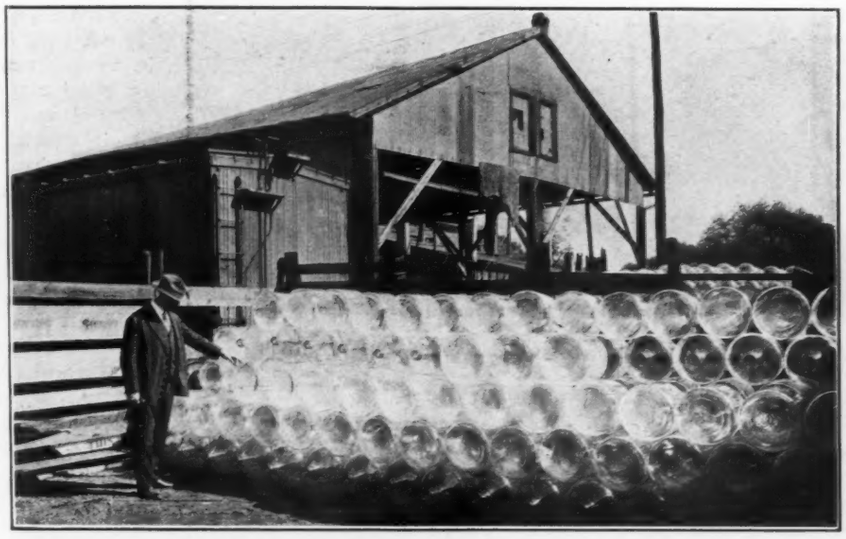
Until three years ago, all compressed air used in the plant was supplied by two steam-driven machines, each having a piston displacement of 654 cubic feet per minute. Both of these units were Imperial Type 10 compressors manufactured by the Ingersoll-Rand Company. Work actually in hand, and other developments under advisement called for more compressed air; and the management was confronted with the problem of choosing another steam-driven unit or some other type of compressor. With operating economy the objective, combined with the need of a machine of greater capacity, the decision—after a survey of the field—was made in favor of an oil-engine-driven compressor of the well-known POC-1 Type. This machine, built by the Ingersoll-Rand Company, was duly installed in 1924; and the unit has a piston displacement of 802 cubic feet per minute—the discharged air going into the service line at a pressure of 45 pounds per square inch. In other words, the POC-1 machine furnishes about 25 per cent. more air per minute than either of the steam units.

Apart from a record of satisfactory service over the three years intervening since the oil-engine-driven compressor was added to the equipment of the Gayner Glass Works, the president of the company, Mr. Edward J. Gayner, has recently said of it: "The unit is absolutely reliable. It has caused less trouble and has taken less care than any other machine on the place." Furthermore, Mr. Gayner states: "The POC-1 costs approximately only one-third as much to operate as either of the steam compressors." This comparison is made on the basis of total costs, and includes fixed charges as well as operating costs.

In the annealing furnace or lehr the containers are successively heated and cooled, thus getting rid of initial stresses that might cause the bottles, etc., to crack afterwards when subjected to changes of temperature.

Before describing how compressed air is utilized in the Gayner Glass Works, and before touching upon some of the manufacturing methods of the plant, it might be of general interest to mention what that establishment produces in the course of a year. The output, for the most part, consists of 150,000 carboys, each capable of holding 12 gallons of acid; 300,000 bottles, each of 5-gallon capacity; and substantially 500,000 battery jars. While the plant does make some Jericho ware—that is, bottles

ranging in capacity from half a pint to one gallon, still most of the smaller containers turned out average half a gallon in capacity. In brief, this widely known glass works takes up the making of containers where most other plants leave off, and, therefore, is notable because of the large sizes of most of the bottles and carboys produced by it.



A lot of 12-gallon carboys ready for packing and shipping.

In the manufacture of battery jars the Gayner Glass Works took a leading place some years ago; and it has maintained its position in this business by developing special machinery for the purpose—compressed air helping to make the performances of these machines successful. We are not permitted to describe these apparatus. Glass battery jars are extensively employed for storage batteries in all kinds of service.

It will probably interest many of our readers to learn how large carboys and water bottles are made in the Gayner Glass Works. At Salem, both human lungs and power-driven compressors provide the air which transforms the gob or gather of glowing plastic glass in blowing the containers with which we are generally familiar. Compressed air does the double service of helping to model the glass and then to harden or set it so that it will retain the desired shape. Perhaps this can be easiest understood if we follow through the stages by which a single 5-gallon bottle is made.

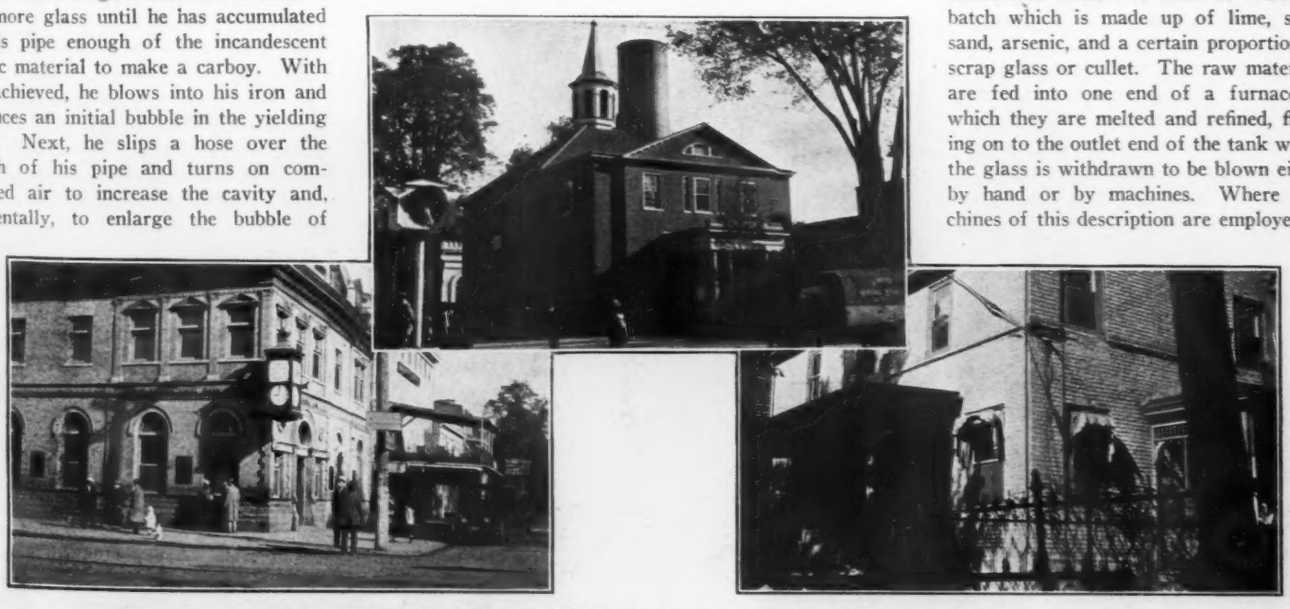
First, the operator gathers on his blow pipe or iron—from a tank filled with molten glass—a quantity of glass, and rolls this on an iron plate. Then he goes back to the tank to add more glass until he has accumulated on his pipe enough of the incandescent plastic material to make a carboy. With this achieved, he blows into his iron and produces an initial bubble in the yielding glass. Next, he slips a hose over the mouth of his pipe and turns on compressed air to increase the cavity and, incidentally, to enlarge the bubble of yellow-hot glass. By now the glass has cooled somewhat and stiffened slightly, so that the bubble must be reheated. This is done by putting the glass in a small furnace, called a "glory hole," that is heated by fuel oil sprayed or atomized with compressed air.

When sufficiently reheated, the bubble is worked on an iron table in a pit—the blower's pipe being held vertically and rotated the while. This operation forms approximately the bottom of the bottle. While revolving the glass on the table, the worker blows with his mouth into the bubble. Everything is now ready to shape the body of the bottle. This is effected by putting the yielding glass into a split iron mold that is kept at the right temperature by heating it with a flame produced by oil sprayed with compressed air. When the glass is enclosed within the mold, compressed air is blown down through the attached pipe, forcing the plastic mass against the walls of the mold.

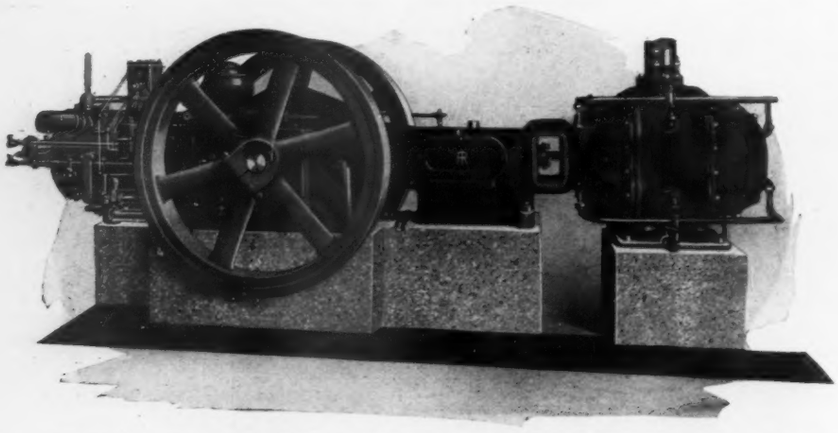
After being removed from the mold, the body of the bottle is cooled to rigidness by a stream of compressed air, and then the ware is again reheated in a "glory hole." When it has been heated to a suitable degree, the bottle is withdrawn and the neck length is formed by revolving the attached iron and by gripping the neck mass with hand-held finishing tools. The tools used by the glass blower are lubricated with powdered carbon and rosin; and the forming block on which the bottom of the bottle is shaped is lubricated with sawdust. With most of the neck thus fashioned, the bottle is skillfully detached by the blower from the rest of the glass still adhering to the blow pipe—the finishing lip of the neck being formed by the next or concluding operation.

When a bottle has thus been produced, it is promptly put into an annealing furnace or lehr, where a moving platform slowly carries it from one end to the other—the temperature increasing or decreasing gradually during the journey. In this way, any internal stresses in the glass—set up during different stages of forming—are released or neutralized, and the bottle is therefore stronger and less likely to break when exposed to a considerable range of temperature in service. The lehr is heated by fuel oil sprayed with compressed air, and the melting tanks are heated with a mixture of air and producer gas. This gas is made in the plant by producers using gas coal.

Glassmaking is a continuous activity; and continuous tanks are used to melt the batch which is made up of lime, soda, sand, arsenic, and a certain proportion of scrap glass or cullet. The raw materials are fed into one end of a furnace in which they are melted and refined, flowing on to the outlet end of the tank where the glass is withdrawn to be blown either by hand or by machines. Where machines of this description are employed in



Top and left—Prominent buildings in the business center of Salem, N. J.
Right—Office of the Gayner Glass Works in Salem.



Oil-engine compressor that furnishes a considerable percentage of the air used in the Gayner Glass Works.

the Gayner Glass Works, they are operated either in part or entirely by means of compressed air.

The actual blowing or machine-making of the glass ware begins each Monday morning at 7.00, and goes on night and day until 4 o'clock of the following Saturday. The furnaces are kept heated continuously from the time of starting operations—including Sundays and holidays—until any of them is shut down to be rebuilt or to receive major repairs.

Before a container leaves the Gayner Glass Works it is tested to make sure that it is sound. Any structural weakness is quickly detected by tapping the bottle or carboy. The experienced ear can tell by the resulting ring whether or not the ware is all right.

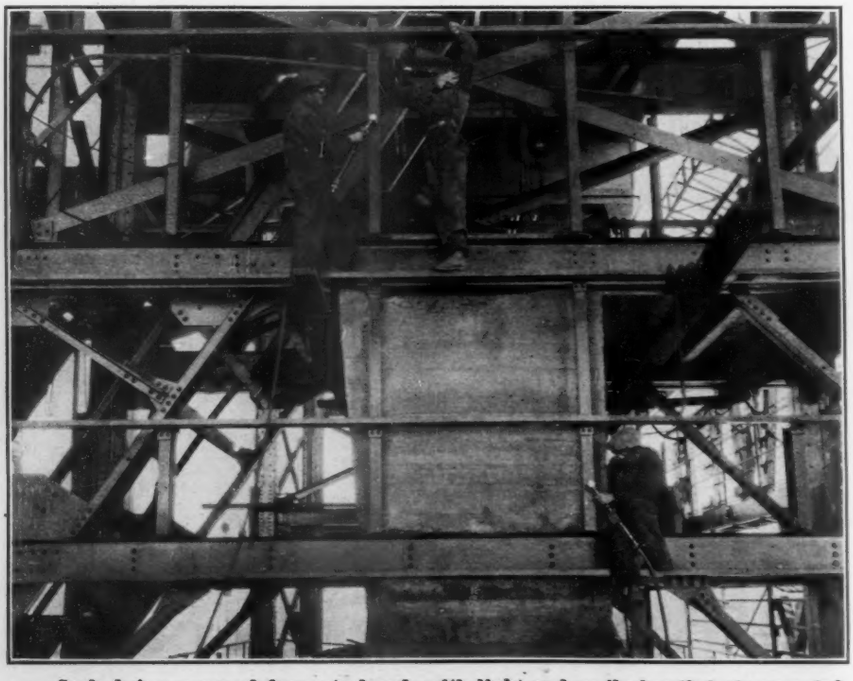
The output of petroleum products from Canadian plants in 1926 was valued at $67,956,301, an increase of $17,000,000 over the preceding year.

PNEUMATIC SCALING TOOL HAS MANY USES

A PNEUMATIC scaling tool has been developed by the Ingersoll-Rand Company, 11 Broadway, New York, for use in cleaning rust, scale, and similar materials from boilers, tanks, bridges, and structural steel of all kinds. It is particularly effective in close quarters, or around rivet heads. The tool consists of only four parts.

The piston projects from the lower end of the barrel, and is finished at the cutting end with hardened teeth. In operation, this piston vibrates back and forth in the barrel at a very high speed. The teeth, which are held against the surface to be cleaned, thus deliver a succession of sharp, quick blows which cut and knock off any rust, scale, or old paint.

Pistons of two lengths are provided. One projects ⅞ inch from the barrel, and has a working face ⅞ inch in diameter. This style piston is supplied in the Size 16 hammer, which is used on flat work and around conehead rivets not more than 1 inch in diameter. The other piston, which is furnished for the Size 16L hammer, projects 2⅛ inches from the barrel and has a ⅝-inch working face. This is especially serviceable around conehead rivets that are larger than 1 inch. The weight of the tool complete with throttle, as shown in the illustration, is 4¼ pounds.



Scale being removed from steelwork with light and easily handled air-operated scaling tools.

LARGE CONCRETE-LINED CANAL FOR INDIA

WORK is shortly to be begun by the Punjab Government on a concrete-lined canal that will be, when completed, the largest waterway of this kind in the world, according to the *Constructional Contractor*. This canal, to be known as the Gang Canal, is to have a total length of 84 miles, of which 73 miles are to be in British and Faridkot territories and 11 miles in Bikaner State. It is estimated that its waters will serve to irrigate 755,000 acres of fertile lands.

The bed of the canal will have a width of 52 feet; the full supply depth will be 8 feet; and the channel will be lined throughout with 6 inches of concrete. The materials for the concrete will be furnished by the Darbari quarries, about seventeen miles from Bikaner, and will consist of four parts screened lime, three parts grit, and twenty parts ballast passing through a 1½-inch mesh. All the concrete on this job will be compacted by the aid of pneumatic rammers, as has been done before on similar work in India. This undertaking is a part of the great Sutlej Valley irrigation project.

AIRPLANES A FACTOR IN DEVELOPING CANADA

TO what extent aviation is helping to bring outlying or rather remote regions of Canada within easy reach of the prospector and the engineer is emphasized by the following statistics given out by one of the several commercial airways that have made it possible to open up the Rouyn gold fields and other mining districts in record time.

Starting with one Fokker monoplane in December of 1926, the Western Canada Airways Company is now operating a fleet of five cabin planes and one light-weight machine. Up to August, last, these aircraft had carried over 1,000 passengers and 200,000 pounds of express matter, traveling in all more than 100,000 miles.

Among the contracts undertaken by this company was the transportation for the Dominion Department of Railways of 8,000 tons of machinery, dynamite, and passengers from rail head at Cache Lake to Fort Churchill. This was accomplished by two machines which covered in excess of 10,000 miles in a month, or well under the time stipulated in the contract.

We learn from *The Engineer*, London, that the Central Electricity Board has appointed Sir Reginald Blomfield to advise them on questions arising in connection with the design and the coloring of transmission towers. This is a step in the right direction, as structures of this kind should be made to harmonize with their surroundings.

Mohawk Trail Again Being Widened To Accommodate Increasing Traffic

THE Mohawk Trail between North Adams and Greenfield, in Massachusetts, is acclaimed by many as revealing to the motorist the choicest stretch of scenery to be found in the Berkshires. In crossing the divide between the Hudson and the Connecticut Rivers, it traverses elevated ground that affords a succession of panoramas of striking beauty. It is a route of great popularity, and is used by hundreds of thousands of cars every year.

This highway of surpassing scenic features holds interest because of its close alliance with the past. It has a well-established claim to antiquity that reaches back to the time when it was a trail in fact as well as in name—a favored footpath of the red man, from whom it derives its name. For countless years before the coming of the colonists it was a link in a system of well-defined Indian trails that extended, almost without break, across the country. As the Indians walked single file, these thoroughfares were only about 18 inches wide and, consequently, became well worn. The trails followed lines of least topographical resistance and, later on, were merely widened to meet the needs of the early settlers. With the advent of the highway engineer, relocation became general; but in the case of the Mohawk Trail the present road probably holds pretty well to the original line that for many generations knew only the tread of moccasin-clad feet.

At the time of the settlement of Albany by the Dutch, the Mohawk Indians occupied the lands to the west of that point and along the Mohawk River. In subsequent years, due to the fact that they were the first tribe to secure firearms, they earned a reputation as warriors that caused the mention of their name to strike terror to the hearts of their foes. To the east of them were the Mohicans, with whom they were often in conflict. The tribes inhabiting New England were also their enemies. In 1650 the Mohawks asked to be allowed to cross the Dutch lands to attack the Penobscots; and in 1662 the English complained against their warfare on this tribe. New England Indians attacked the Mohawks in 1669, but were repulsed with the loss of their leader and 300 men. In reprisal, the Mohawks made a raid into New England. During all these hostilities, the attacking parties crossed the mountains by the Mohawk Trail.

Some of the New England Indian tribes were driven out by the whites prior to 1700 and sought refuge in Canada. Among them were the Pennacooks and the Abnakis. Also, at Chaughnawaka, on the St. Lawrence River, was a settlement from the Oneidas and the Mohawks of New York. Inasmuch as those people spoke the Mohawk language, they were known as French Mohawks. It was the French that led those Canadian Indians on their attacks against the New England whites. The path of the invaders was up the Richelieu to Lake Champlain, along that waterway to its southern tip, whence they crossed the Hudson and continued overland to Eagle Bridge, joining the familiar trail up the Hoosic, across the divide, and on down Deerfield Valley. Thus the original Mohawk Trail extended into Canada and derived its name from two branches of the Mohawk Indians. It was followed in after years by thousands of soldiers, in connection with whose activities the great forts of Ticonderoga and Crown Point were constructed. The decisive battle of the Revolutionary War was waged close to the trail at Schuylerville. The Bennington battlefield may be seen from the present road.

During the period of Dutch settlement, the trail on both sides of the pass was widened into a suitable roadway. In 1753 Elisha Hawley was granted public money to build the connecting link through the pass. Eleven years later Samuel Rice, claiming to have found a better route, was granted 200 acres of Province land in return for constructing a new roadway. In 1786 a third road was built. The first and third were toll highways. Those who desired to avoid the payment of this toll used Rice's Road, which thus acquired the name of the "Shunpike." The third road followed the original trail more closely than the first two and became the route for the present highway. Perry's Pass, where the motorist reaches a vantage point from which he can see into three states, is known to have been included in every trail and road through that section from the first to the latest.

Top, left—"Jackhamers" at work clearing away rock in widening the Mohawk Trail. Right—A stretch of the Mohawk Trail where it rises to the highest point overlooking North Adams.
Bottom, left and center—Views from the trail looking down into the valley in which North Adams lies. Right—The Ingersoll-Rand portable compressor that furnishes operating air for the "Jackhamers."

Modern Methods Mark Prospecting In Rouyn District

By E. K. HARTZELL

THE Rouyn district, in the Canadian Province of Quebec, continues to give promise of becoming one of the most important sources of gold and copper on the North American continent. Prospecting and exploratory work are being carried on extensively; and it is notable that painstaking, systematic methods are being in large part employed in exploiting that field. This is in sharp contrast to the crude, haphazard activities that characterized the search for mineral in opening up the older districts. This new order of things is made possible for the most part through the availability of highly efficient, air-operated rock drills, and of other modern mechanical equipment that were denied the picturesque prospector of former periods.

The practices that are being followed in opening up prospects in the Rouyn area may be illustrated by briefly describing the work done on the property of the United Verde Extension Mining Company interests. Following a well-defined plan, a vertical shaft has been sunk to a depth of 235 feet. A station has been cut at the bottom; and from that point drifting and crosscutting are being carried on.

Pending the installation of machinery, the sinking of the 7x11-foot shaft was started by hand and in this way excavated to a depth of 34 feet. By the time this was accomplished, an Ingersoll-Rand PRB-2 compressor with a capacity of 720 feet had been put in place; and work was continued with four N-72 combination sinking-and-drifting drills. Of these three were used at a time and the other was held in reserve. Other equipment included an 8¼x10 SSR air hoist, and an 8x4x12 VPS Cameron sinking pump.

Excellent headway was made with this equipment, and 38 days after it was put in service the remaining 201 feet of shaft had been sunk and 215 feet of timbering placed. The actual working time was 36 days. Four miners were employed on a shift, making a total of twelve on the three shifts. The procedure followed was to drill an entire round at a time, and then to shoot the cut holes only. After the resulting muck had been loaded and hoisted, the remaining holes were shot and the spoils removed.

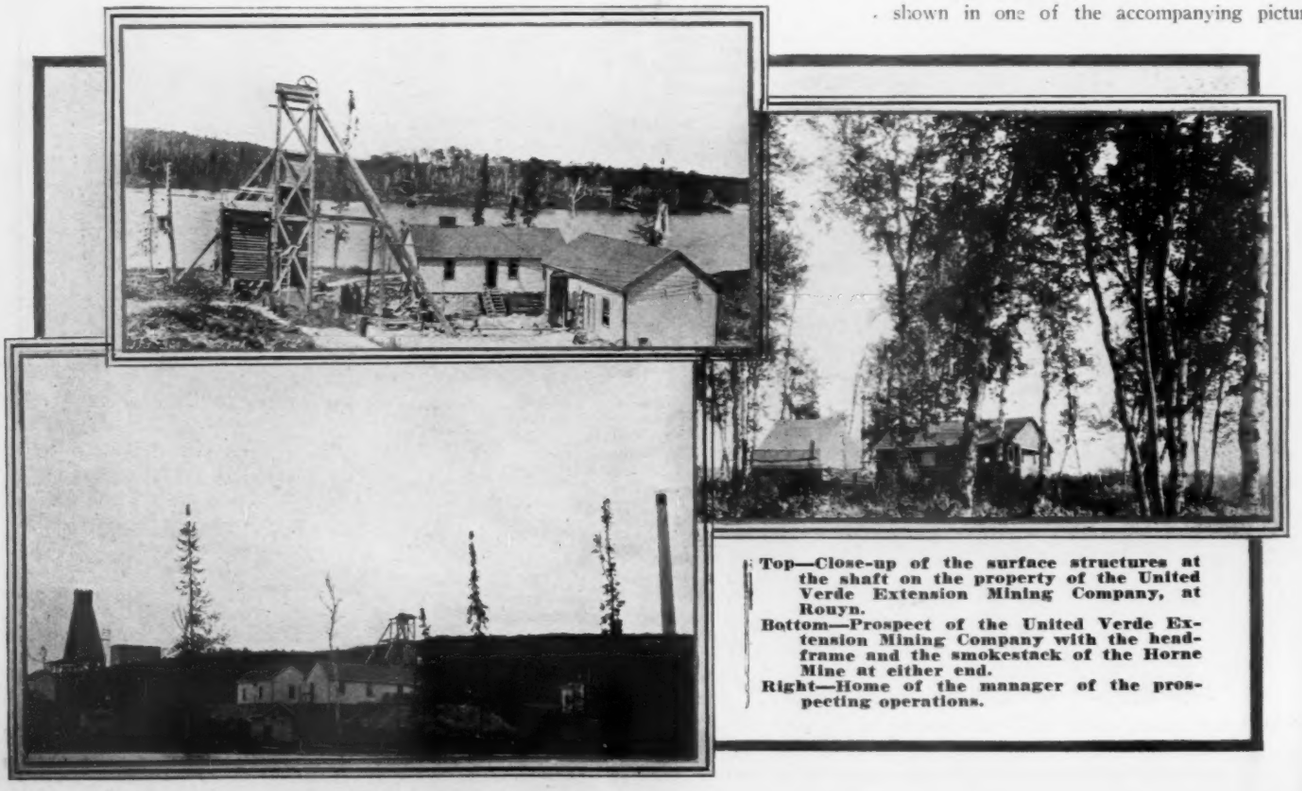
A round constituted an advance of 6½ feet. This footage was broken daily for six days a week—one day being devoted to timbering. The daily average advance was thus about 5.6 feet. The shaft was started in a rhyolite formation, in which a round could be drilled in about three and a half hours. A hard diabase was then encountered; and between five and six hours were required to complete a round in this rock. The steel used was I-R 1⅛-inch hollow hexagon; and five changes of steel were made to a hole. The starting bits were 1⅞ inches in diameter. The longest pieces of steel were 8 feet, with 1⅜-inch bits. For reconditioning steels, a 5F oil furnace and a No. 4 "Leyner" sharpener were employed. Drills were lubricated from a common oiler placed at the collar of the shaft.

On the first 100 feet of work there was considerable overbreakage of rock, necessitating the handling of 50 per cent. more spoils than would have resulted from clean breakage to lines. The percentage distribution of time consumed by the various operations was as follows:

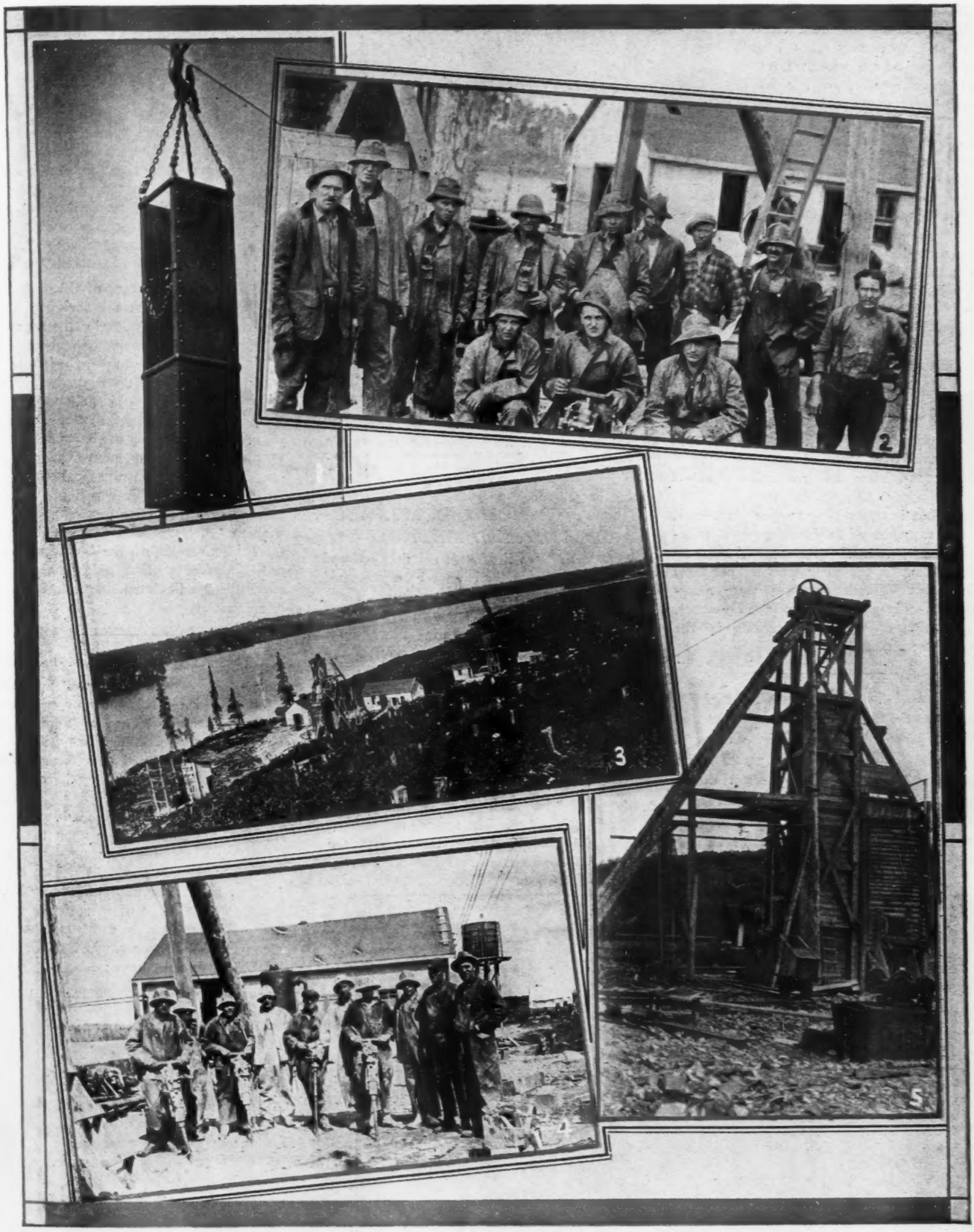
	Per Cent.
Drilling	19.6
Blasting and blowing smoke	11.3
Mucking	48.2
Timbering	13.6
Power failures	5.3
Delays	2.0

The cost per foot of shaft amounted to $46.03, and this was divided up as follows: Labor, $33.53; explosives, $5.80; and timber, $6.70. The item for labor includes the total payroll and the manager's salary.

The record made on this work has seldom, if ever, been excelled in Canada in sinking a shaft of this size. It was rendered possible by the knowledge, experience, and skill of those who took part in the work, by the use of dependable and efficient machines, and by the employment of special equipment in connection with the handling of materials. Among these last-named features was a dumping arrangement at the top of the shaft which permitted speedy disposal of the muck. A box used for lowering and raising drill steels in the shaft is shown in one of the accompanying pictures.



Top—Close-up of the surface structures at the shaft on the property of the United Verde Extension Mining Company, at Rouyn.
Bottom—Prospect of the United Verde Extension Mining Company with the headframe and the smokestack of the Horne Mine at either end.
Right—Home of the manager of the prospecting operations.



Some views of the United Verde Extension's work at Rouyn.
1—Box used for handling drill steels in the shaft.
2—The three shifts of miners who made an imposing record in shaft sinking.
3—Scene of the work, with Lake Osisko in the background.
4—Two shifts of miners, with the N-72 drills that proved highly effective.
5—A close-up of the headframe above the shaft.

STONE CHANNELING AN ANCIENT ART

THE antiquity of stone channeling apparently dates back to the days of the ancient Egyptians. Confirmation of this has been brought to general attention recently by the following extract from the *Quarry Surveyors & Contractors' Journal,* of London.

"The channeling of rock was known and carried out by the Egyptians 5,000 years ago, as a perfect example of channeled limestone rock has been found and dug up at Sakkara, near the Step Pyramid. The holes appear to have been bored about 2¼ inches in diameter by means of a rotary drill, the bits being made of flint, a number of which have been dug up. They were thought at one time to be ornaments, being more or less in the form of a crescent.

"One does not know if there are any examples of channeling in the harder rocks, such as granite, found in upper Egypt; but the writer, when in upper Egypt a few years back, saw only examples of the breaking up of granite blocks by means of the cutting of slots, no doubt cut out in the early days by hardened copper tools. Wooden wedges were afterwards driven in and then soaked with water, the expansion of the wood cracking up the blocks to the required sizes."

The State of South Carolina plans to build a dam across the Saluda River, 10 miles west of Columbia, for the purpose of impounding a lake 30 miles long and 14 miles across at its greatest width. The entire project will cost more than $20,000,000; and includes the construction of what will be, so it is said, one of the largest hydro-electric plants in the United States.

Spray painting has greatly bettered the illumination of this machine shop. Note the difference between the front section, which has been painted, and the rear section awaiting painting.

SPRAY PAINTING COMPARED WITH HAND METHOD

COMPARATIVE data on painting by hand and by spray methods have been published in this Magazine from time to time. These figures have generally shown that for most kinds of work the choice is in favor of the paint spray, by means of which it is possible to cover a given surface with more paint in less time. There are cases, however, such as the one we are going to describe, where, at first glance, the hand method seems to be cheaper.

In order to obtain specific comparative data on the cost of painting by hand and by air spray, a large manufacturing establishment recently painted half a building by one method and half by the other. The surface painted was galvanized iron. The ridge of the roof was the dividing line; and each half had an area of 1,111 square feet. The same kind of paint, at $2.50 per gallon, was used in both instances. The labor cost was constant, being 55 cents an hour.

It took 7 hours of labor and 7½ gallons of paint to cover the given surface by the spray method—the respective costs being $3.85 and $18.75, or a total outlay of $22.60. In the case of the hand method, it required 14 hours of labor, costing $7.70, and 5 gallons of paint, amounting to $12.50—a total of $20.20—to do the work.

On the face of things it would appear that the saving of 50 per cent. on labor by the spray system was more than discounted by the consumption of 33 per cent. more paint; and, further, it would seem that 2½ gallons of paint were wasted. However, a close examination of the work served to show that none of the paint sprayed on was wasted by spattering, as it was found to be in place and doing effective service as a protective agent. A comparison of the finished surfaces on both sides of the building revealed that the sprayed portion looked like a 2-coat job and the hand-painted side looked like a 1-coat application.

Operator at work spray painting the surfaces of the walls of the machine shop.

SIGNIFICANT BIRTHSTONES

AS the season of "supergiving" approaches, and once more the purveyor of personal adornments parades his wares a-glitter with stones—precious and otherwise—we are reminded that the appended list, which appeared in *The Jewelers' Circular,* may be of service to the hard-pressed male bent upon finding something set with a suitable birthstone.

This list—a clever travesty upon the calendar of stones generally accepted—was composed by a jeweler, in Seattle, Wash., possessed of a sympathetic sense of humor. The list, so modified, has the merit of a much wider personal application than is commonly the case with the usual birthstones. Mr. C. G. Sutherland, the author, suggests:

For laundresses—the soapstone.
For diplomats—the boundary stone.
For architects—the cornerstone.
For cooks—the puddingstone.
For Bolsheviks—the bloodstone.
For sugar dealers—the sandstone.
For taxi drivers—the milestone.
For Irishmen—the Blarney Stone.
For borrowers—the touchstone.
For pedestrians—the paving stone.
For stockbrokers—the curbstone.
For burglars—the keystone.
For manicurists—the pumice stone.
For tourists—the Yellowstone.
For beauties—the peachstone.
For geniuses—the tombstone.
For most of us—the grindstone.
For all of us—the diamond.

Canada Reveals Her Mineral Resources To Empire Congress Tourists

Cosmopolitan Group of 400 Is Given Close View of Dominion

By ALLEN S. PARK

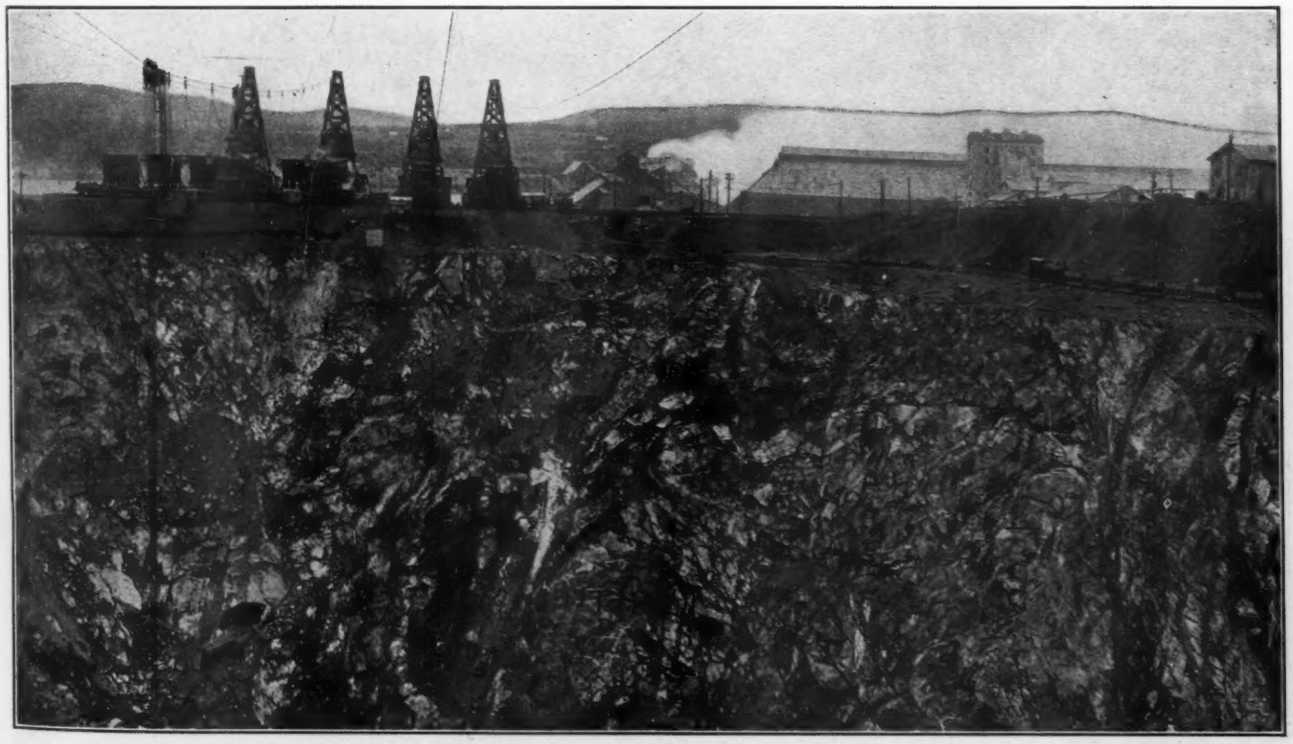
THE British Empire Mining and Metallurgical Congress Tours are conducted every three years. Their purpose is to give capitalists, engineers, and other interested persons an intimate, first-hand view of what the far-flung domain of John Bull harbors in the way of mineral resources, of the development that has taken place, and of the opportunities that are offered for further exploitation. The first of these illuminative group travel studies was held in 1924, with the British Isles as the field of observation; the second was recently brought to a close in Canada; and the third is projected for South Africa in 1930.

The Canadian tour just made attracted 400 persons. The British Isles sent 150, and representatives were present from Australia, New Zealand, India, the Federated Malay States, and various sections of South Africa, including Rhodesia, the Gold Coast, Nigeria, etc. Delegates also came by invitation from the United States, France, Belgium, Czechoslovakia, Germany, and Russia. During the five weeks allotted to the Congress, the delegates traveled more than 8,000 miles; visited the principal mining districts of the Dominion; listened to the reading of carefully prepared technical and industrial papers by qualified authorities; met the leading civic and provincial officials wherever they went; glimpsed the scenic wonders that loomed on all sides; marveled at the agricultural and the power developments; and topped off their strenuous activities with numerous social and recreational digressions. Everywhere, their goings and comings were arranged in advance for them; and all phases of the undertaking were organized and coördinated under the direction of Major George C. Riley, chairman of the main committee, who was ably assisted by George C. MacKenzie, secretary of the Canadian Institute of Mining and Metallurgy, and Major R. O. Wheatley, M. C., associate secretary. At every point of the itinerary, the greatest possible coöperative effort was put forward by the local people to make the tour an unqualified success.

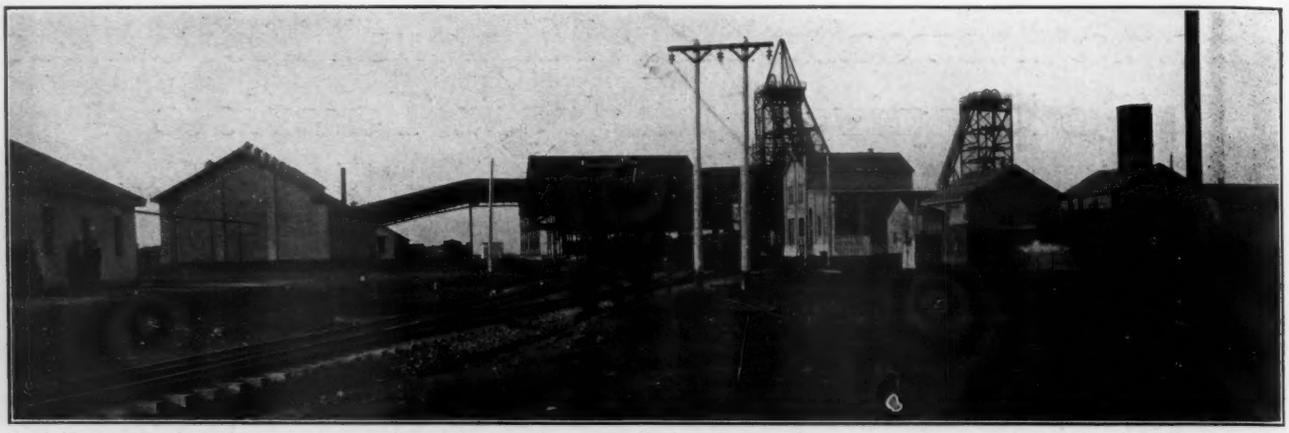
Overseas visitors, who made up the major part of the attendance, expressed themselves as impressed chiefly with the unfailing optimism of the Canadian people; the magnificent distances in Canada; and the limited extent to which the apparently boundless mineral resources of the Dominion have been developed to date. Other considerations that called for particular attention were her vast wheat fields that produce one of the Dominion's most important crops and contribute generously to the world's food markets; the numerous lakes and rivers, with their power developments; the stately grandeur of the Rockies; and the amazing progress that has been made in the building of towns and cities.

From their meeting point, in Montreal, the tourists started in three special all-steel trains for a trip to the Pacific Coast and back. A few days later, one train left the west-bound party for the Atlantic Coast and intermediate points of interest. Before the departure from Montreal, the inaugural session of the Congress was held in Windsor Hall, where the Right Honorable Sir Robert S. Horne, G. B. E., K. C., M. P., Honorary President of the second Triennial Empire Mining and Metallurgical Congress, and the Honorable Charles Stewart, M. P., Minister of Mines for the Dominion of Canada, welcomed the guests to the Dominion. A luncheon and a banquet were addressed by various prominent personages—in fact, it was freely remarked that the best brains of the Dominion were gathered there to help launch the Congress under conditions auguring success.

At Ottawa, the first stopping place, the party were the guests of the Governor General of Canada, Lord Willingdon, Lady Willingdon, and the Honorable William Lyon MacKenzie King, Premier of Canada, at a banquet and



Open-pit asbestos workings of the King Mine at Thetford, in the Province of Quebec.



Surface structures at Colliery No. 1B of the Dominion Coal Company, Sydney, N. S. The workings extend far out under the ocean.

dance. While at Ottawa, the Departments of Mines and other places of interest were visited. The next objective was Toronto, where Toronto University was Congress headquarters for three days while side trips were made to Niagara Falls, the power plants at Niagara, the steel works at Hamilton, and the nickel and copper refineries at Port Colborne. From Toronto the party traveled by night to Sudbury where the world's greatest nickel mines were viewed. Opportunity was afforded to inspect the surface and the underground properties of the International Nickel Company and the Mond Nickel Company, and to gain an idea of the long life that is assured the workings because of the tremendous reserves of proved ore bodies. Many of the tour members were surprised to learn that the nickel mines are large producers of copper, and that they are one of the world's few sources of platinum, osmium, and iridium.

Near Sudbury the delegates had an opportunity of examining the Errington Mine of the Treadwell-Yukon Company, a subsidiary of the famous Bunker Hill & Sullivan Mining Company. This property, only recently opened up, already shows promise of developing into one of the largest mines that have been discovered anywhere in the world within the past 25 years. It is the outgrowth of efforts put forward two years ago by Joseph Errington and F. W. Bradley to interest the Bunker Hill & Sullivan Mining Company, of Idaho, in the deposits of the region. Hundreds of claims have been staked; and many farmers have disposed of their mineral rights at high prices. Indications are that extensive plants for the treatment of lead and zinc ores will soon rise on the flat surface of Sudbury Basin and within sight of the smoke from the immense nickel-copper works that give the world 90 per cent. of its supply of nickel.

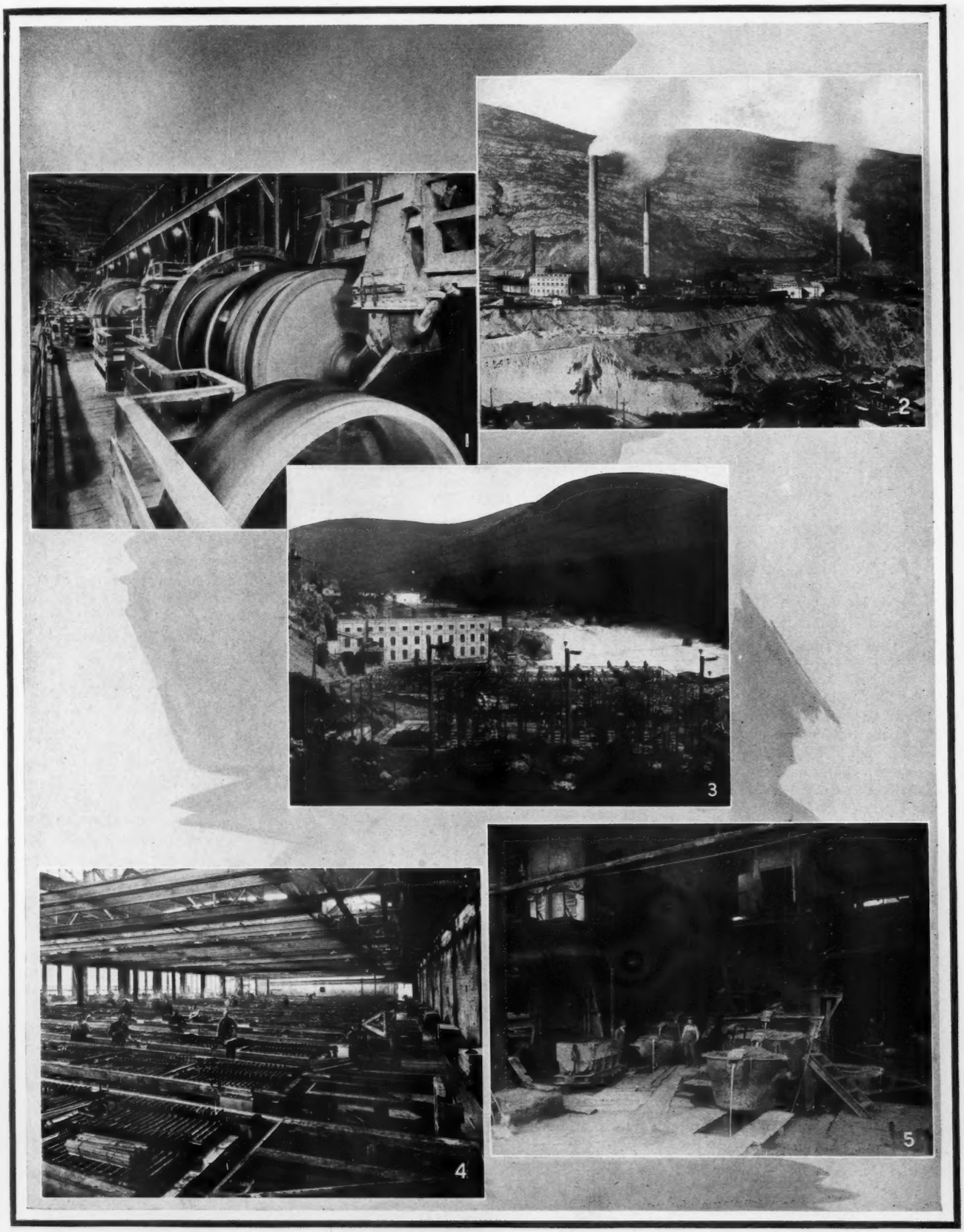
Sudbury, Cobalt, and Porcupine form a mineral triangle in Ontario. Cobalt, which lies at the right angle of the figure, was the next objective. It was discovered in 1903, and is the center of the silver-cobalt mining industry. It has yielded millions in profits to operators of comparatively small mines. Veins a few inches wide, carrying values in silver that ran in many cases from $1,000 to $3,000 to the ton, were the treasure trove in these properties. Later on, the low-grade ores that required concentration were exploited; and there grew up a notable metallurgical technic for their treatment.

At Ragged Chutes, midway between Cobalt and South Lorrain, the party visited a unique air-compressing plant. Advantage is taken of the falling waters of the Montreal River—the air being trapped in a tower leading to a tunnel under the river. The air is used in some of the silver mines in the Cobalt area. This plant and one similar to it at the Victoria copper mine in Michigan were designed by C. H. Taylor, of Toronto.

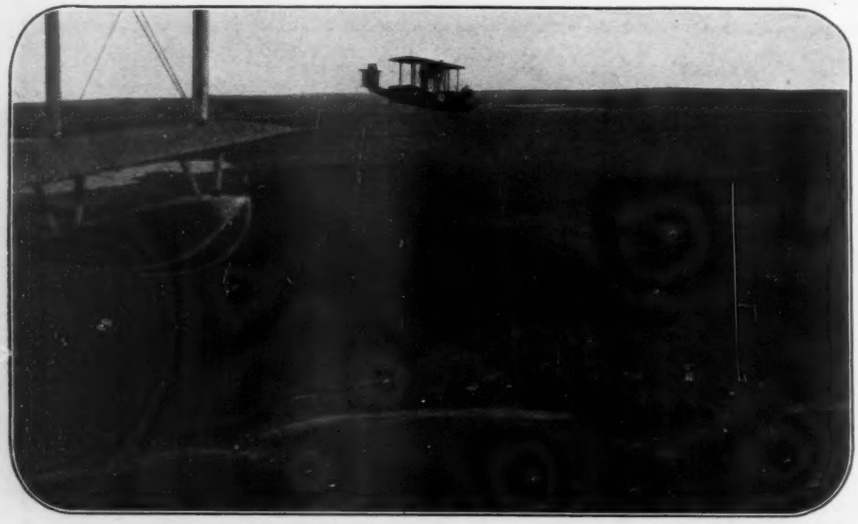
Traveling northward, the group next reached Kirkland Lake, where they inspected the Wright-Hargreaves, Lake Shore, Teck-Hughes, Kirkland Lake, Sylvanite, and Tough-Oakes gold mines. In part, the ore zone extends beneath the lake; and the rich deposits are proving even larger than was expected. The equipment of the mines and mills constitutes a display of mechanical installations most suitable for the mining and the treating of the kind of gold ores found there. The district is second in annual production among Canada's gold-mining regions, and is sometimes rated first in point of future prospects. The camp came into being as a result of prospecting work done by Harry Oakes and Will Wright, the former from the western section of the United States, and the latter from England. They entered the area fifteen years ago, and both of these men are now at the heads of companies operating the mines that have grown from the claims they staked.

Leaving Kirkland Lake the trains proceeded over the Transcontinental lines to Timmins, the

General view of the Hollinger Mine, in the Porcupine mining district. The Hollinger is Canada's largest gold producer. In the foreground a lake has been filled in with tailings from the mill.



1—Marcy rod mills, which have supplanted stamps for crushing the ore at the Hollinger mill.
2—The great smelting works at Trail, B. C., that handle much of the ore produced by the Sullivan Mine.
3—The hydro-electric plant, at Lower Bonnington Falls, B. C., which generates the power used by the Consolidated Mining & Smelting Company.
4—Zinc tankroom in the Consolidated Mining & Smelting Company's plant at Trail, B. C.
5—The Trail smelter, showing the copper furnaces.



Aircraft of the Royal Canadian Air Force flying over the eastern shore of Lake Winnipeg. This view shows the general nature of the Lake Winnipeg mining district.

center of the Porcupine district. Porcupine was of particular interest, as it is Canada's oldest gold camp of note and also because it is the home of the Dominion's largest gold mine, the Hollinger. Other prominent mines there are the Dome and the McIntyre; and among the numerous smaller mines of promise in this area are the Coniarum, Porcupine Pay-Master, Vipond, and Ankerite. The Hollinger, being most widely known, drew the greatest attention. The magnitude of the operations; the excellence of the underground haulage system; and the manner in which worked-out openings are filled with sand and gravel from deposits four miles away, were matters of comment. At the Hollinger mill, 7,000 tons of ore are handled daily. The crushing of the ore is now done by rod mills instead of by stamps; and this and numerous other modern practices became the subjects of study.

At the McIntyre Mine, where a new shaft had just been finished, the cage made its first trip down this 17x24-foot shaft in honor of the distinguished guests. Its sinking to a depth of 4,150 feet was an outstanding achievement—the rock having been drilled and excavated at the rate of 5 tons per man per shift. The surface equipment is notable. It includes an all-steel headframe and a hoist capable of bringing its 20-ton load to the surface at a speed of 3,000 feet per minute. Both the McIntyre and the Dome mines have special furnaces for heating drill steels, and these were given careful scrutiny. To guard against overheating, these furnaces automatically eject steels when they reach a certain temperature.

En route from Timmins to Winnipeg, twenty of the party left the train at Minaki for a visit to the Howey Mine and other promising properties in the Red Lake district, covering the distance by aeroplane. At Cochrane, the trains separated, two going west and one east. The Pacific-bound trains stopped at Estevan, an important center of the lignite-coal-mining industry. From Banff, side trips were made to the collieries at Canmore and to the mountain resort of Lake Louise.

To many of the delegates the most interesting part of the whole trip was the visit to the famous Sullivan Mine of the Consolidated Mining & Smelting Company of Canada and to the smelter at Tadanac. The Sullivan Mine produces a large part of the ores that are treated in the Kimberley concentrator and the Tadanac smelter. In the face of great metallurgical difficulties, the engineers of this well-known company have brought the operations to such a point that the Sullivan Mine is now the largest producer of lead and zinc in the British Empire. The Consolidated Mining & Smelting Company has interests in many other properties in British Columbia, and is conducting a search for mining prospects in many parts of the Dominion and as far afield as Newfoundland. The company went to a great deal of trouble and expense to entertain the delegates, who were shown through all parts of the mine and the smelter and who were taken to see the hydro-electric plant at Bonnington Falls, where the power is generated that is used in the electrolytic processes at Tadanac.

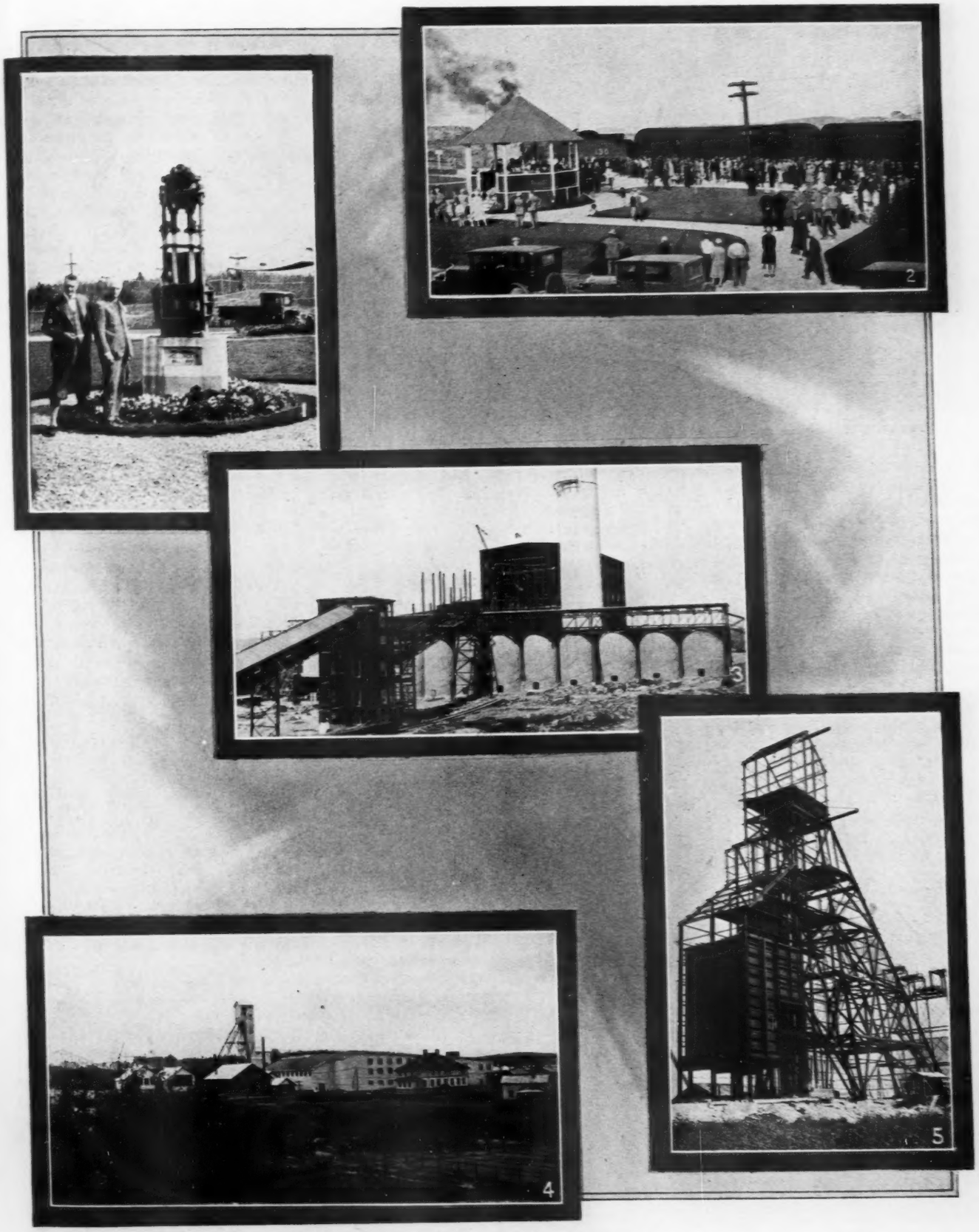
Turning their course eastward, the tourists visited Jasper and adjacent mines, Wainright National Park, Saskatoon, Fort William, Port Arthur, the newly developed copper-gold region at Rouyn, the City of Quebec, the asbestos mines at Thetford, and concluded their journey at Montreal.

The eastern party, after leaving Cochrane, went first to Rouyn where the famous Noranda Mine of the Horne Copper Corporation is located and where that company has just completed a new 1,000-ton-per-day smelter. The mines of this company are exceptionally well equipped, and were viewed with interest and profit. The visitors were amazed, in the light of present developments, to learn that this area was an unbroken forest expanse three years ago. It is now reached from the north by a railroad, and another line from the west will soon be in operation. During the early stages of the camp, millions of dollars in ore were opened up with power furnished by two small wood-burning plants. Now, electric power is being transmitted across 50 miles of wilderness from Les Quinze.

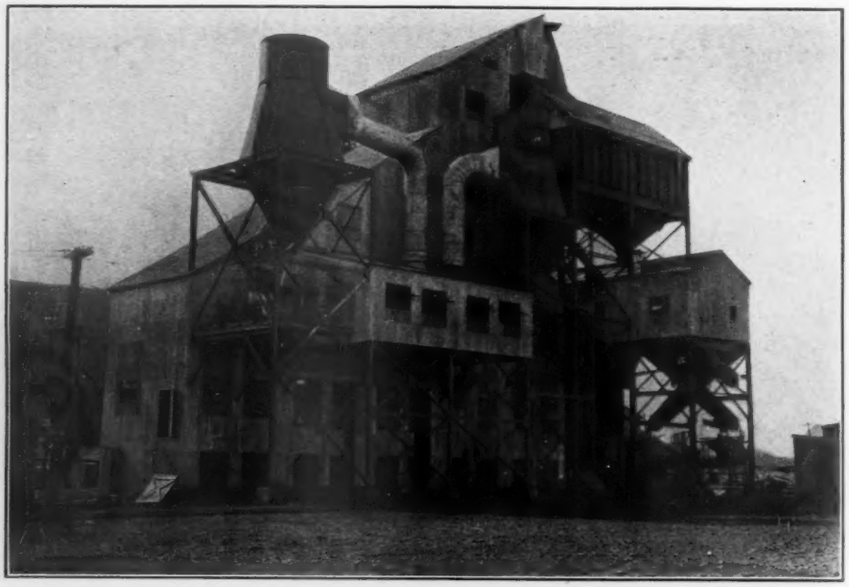
From Rouyn the route led to Chicoutimi, which is an important industrial center where great quantities of wood pulp are manufactured —60,000 tons, in dry form being exported annually to Great Britain. The industrial development in the Lake St. John and Saguenay River area, founded on the vast available power resources and railroad facilities, is rapidly transforming the valley from an important agricultural region, supporting a population of 60,000, into a manufacturing district with a current program of expenditures aggregating $100,000,000. The Aluminum Company of Canada is completing an important development there, including the construction of large works and the creation of the Town of Arvida. The basic mineral, bauxite, will be mined in British Guiana and transported by steamer and rail to the smelting plant at Arvida.

At Thetford, in the eastern section of Quebec, the party saw the mines that supply the world with most of its asbestos. The mining is done principally by the open-pit method; and

Searching for mineral with a diamond-drill outfit on the Nipissing property, Montbray Township, Que.



1—The original Hollinger Mill, preserved in the form of a monument.
2—The first of the three special trains of the Congress leaving Timmins en route to Cochrane and the western coast.
3—The 1,000-ton smelter which the Horne Copper Company is building at Rouyn.
4—General view of the Teck-Hughes property, one of the leading mines of the Kirkland Lake District.
5—A new shaft, 4,150 feet deep, has just been sunk at the McIntyre Mine at Porcupine. This picture was taken while the steel headframe was under construction.



The steel tipple and the coal-cleaning plant of a colliery at Coleman, Alta.

the cableway hoists in operation there proved of much interest. From Thetford the party traveled to Sydney, Nova Scotia, passing en route through East Angus, a large pulp and papermaking center; Sherbrooke, the hub of the eastern townships and the mining-machinery center of Canada; Stoney Creek, where gas and oil fields were seen; and Hillsboro, where gypsum mines and mills were inspected. On their arrival the delegates were hospitably entertained by officers of the Dominion Coal Company and shown through its No. 1B Colliery in the Sydney field, which is notable because much of the coal is won from workings two miles out under the ocean. This colliery supplies a great deal of the coal used in the vast steel plants of the British Empire Steel Corporation. The hoisting, ventilating, and pumping equipment in these workings especially attracted the attention of the delegates.

The steamship *Cariboo* then carried the tourists from Sydney to Port-aux-Basques, Newfoundland, from where they proceeded by rail to St. Johns. There they were welcomed by the Mayor; and among the distinguished guests at a dinner given in their honor were the Governor, the Prime Minister, and the Chief Justice of Newfoundland. From St. Johns the party were taken by steamer to Belle Isle where the Wabana iron-ore mines are located. Like the Sydney coal-field workings, these are subaqueous in character. The room-and-pillar system of mining is followed. Mechanical shovels do most of the loading, though scraper-loaders also are employed with success. The ore is hauled up slopes; is trammed to bins at the piers; and thence is loaded aboard ship by means of bucket conveyors. The daily production is about 4,000 tons, of which a large percentage goes to Germany. Red Indian Lake, where a promising zinc deposit is being developed, was included in the itinerary. A plant adapted to the treatment of the complex ore of zinc, lead, and copper sulphides is now being built.

Important technical sessions were held at various points en route. Lack of space forbids a full presentation of the papers and their authors' names. Suffice it to say that these papers were diversified in subject matter and exacting in their treatment of the questions considered.

It was notable that many of the visitors from abroad required some little while to orient themselves in their new and unaccustomed surroundings; but as time went on the spirit of toleration with which they had at first greeted the new land gave way to surges of admiration and, eventually, the grip of the country's fascination and charm seized them. Canada has become a reality with them, and through them it will be presented to thousands of others in the same light as they saw it.

The delegates saw Canada under average conditions and were, therefore, able to get a good idea of her scenery, climate, crops, industrial activities, etc. Hospitality was showered upon them; and the pride and the optimism of the people were evident at all times. The visitors were made up of representatives from various walks of life. There were many emissaries of large financial interests; a generous quota of mine managers, engineers, and geologists; a number of college professors; and many government officials. The cosmopolitan character of the gathering, itself, made it an interesting field for study.

Officially, the Canadian Institute of Mining and Metallurgy acted as the convening body. Among the guests were representatives of the Institute of Metals; the Institution of Mining Engineers; the Institute of Mining and Metallurgy; the Iron and Steel Institute; the Institute of Petroleum Technologists; the Chemical, Metallurgical and Mining Society of South Africa; the South African Institution of Engineers; the Australian Institute of Mining and Metallurgy; and the Mining and Geological Institute of India—all constituent members of the Congress. There were also present members of other institutions, including delegates from the American Institute of Mining and Metallurgical Engineers.

COACH WITH AIR-OPERATED DOORS AND BRAKES

A NEW type of motor stage, called the twin coach, has been designed and built by Frank R. Fageol. This coach is unique in many ways, its chief claims to distinction being that its passenger-carrying capacity is from 40 to 50 per cent. greater than that of kindred vehicles, with a correspondingly large saving in weight, and that it makes more effective use of the space it occupies. These things are accomplished by a counterbalanced construction, that permits reductions in weight, and by utilizing the entire length and breadth of the car for loading purposes.

The basic difference between this type and many others is that the coach in question is so designed that its weights are disposed symmetrically. The wheels are uniformly loaded; the spring mounting is also uniform all around; and the stage has virtually no tendency to pitch even on very rough roads. By splitting the power plant in two all stresses are halved. This makes it possible to mount the engines in the center of the car and on the outside, where they are readily accessible. The twin coach is equipped with 4-wheel Westinghouse metal-to-metal pneumatic brakes; and the doors are opened and shut with compressed air.

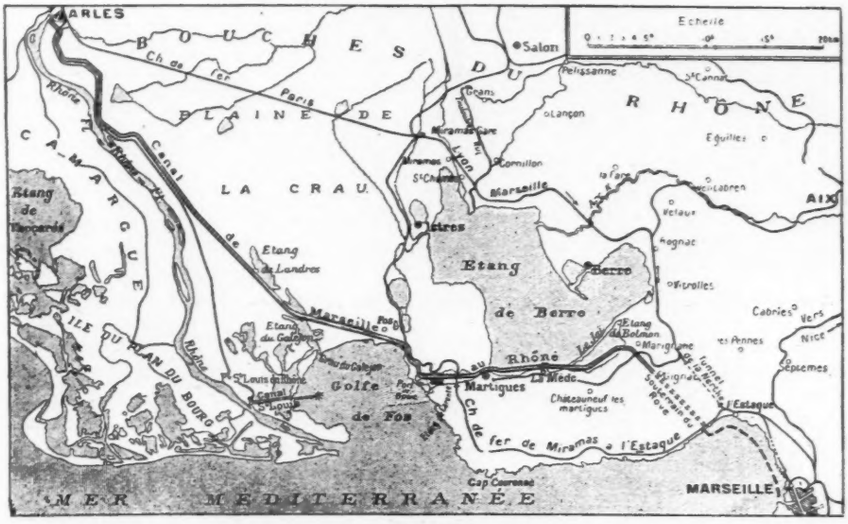
Motor coach equipped with 4-wheel pneumatic brakes and air-operated doors.

Important Link In Marseille-Rhone Canal Opened To Traffic

Additional Details About the Rove Tunnel and What it Means to the Future of the Port of Marseille

By H. VILLETARD*

THE Rove Tunnel, that will ultimately form an integral part of the proposed 50-mile canal that is to connect the Port of Marseille, on the Mediterranean, with the Rhône River, at Arles, was described more than five years ago in Compressed Air Magazine. At that time, the top headings had been substantially completed, but there still remained the work of finishing the masonry of the revetment walls and of removing the bench. This underground waterway, by far the most important part of the entire canal project, is now open to traffic. It is approximately 4.35 miles long, 72 feet wide, and 51 feet high; and links the Port of Marseille with the Etang de Berre—hitherto a land-locked body of water.



Route that will be followed when the Marseille-Rhone Canal is completed from Arles to the Mediterranean Sea. At the present time this great undertaking is finished from the Etang de Berre to La Lave, at the south end of the Rove Tunnel.

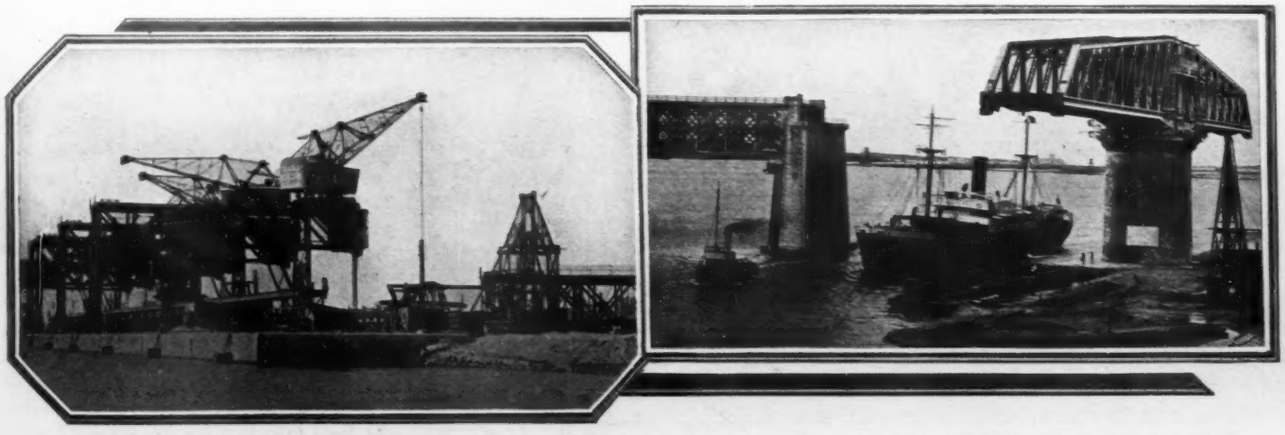
Construction on the Rove Tunnel was begun in 1911, but was much interfered with as well as influenced by the World War. From August 1914 on until early in 1920, the work was carried on by a much reduced force. However, even at that time, owing to financial difficulties, it was not possible to obtain the necessary appropriations to drive the headings and to remove the central core and the bench. As originally planned, these three stages of the undertaking were to be completed without delay; but, because of a lack of funds, the headings were not finished until 1923; the core was removed by the end of 1924; and the excavating of the bench was accomplished in 1925, as specified in the modified program of 1920.

The bench profile of the Rove Tunnel was not uniform: it varied according to the nature of the rock. But, whether the rock encountered was hard or soft, a 6.5-foot towpath was left along each tunnel wall. When hard rock was struck, the practice was to carry the heading to a point 3.5 feet above water level. The towpaths thus formed by the underlying rock were then faced with a masonry wall having an average thickness of 2 feet. But whenever the rock was soft, the arch was extended 16.5 feet below water level, and the towpaths were supported on masonry pillars connected by means of small concrete arches.

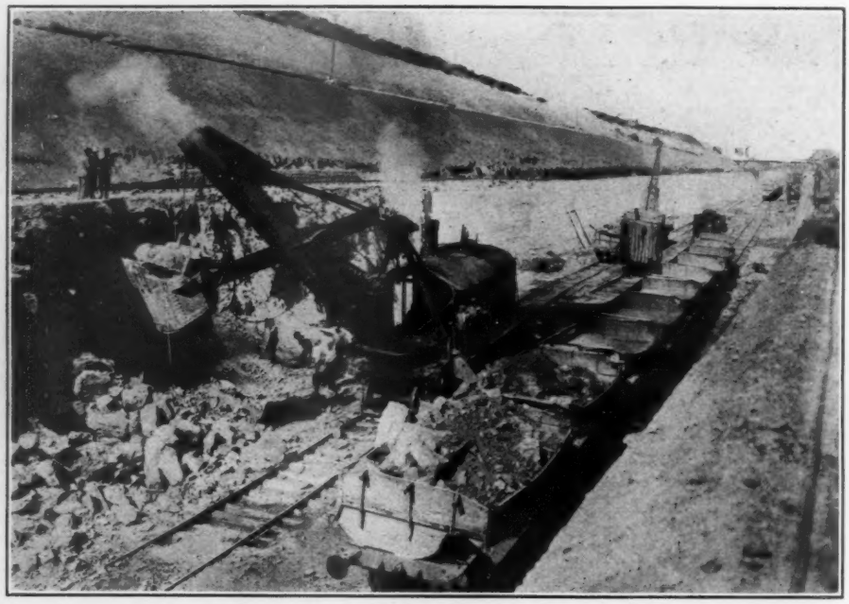
Work on the lower bench—which was merely reinforced with a 2-foot wall—presented no engineering difficulties. First, an excavation was dug, 23 feet wide, and this was then enlarged to accommodate the retaining walls. Inclined shafts, that had been sunk previously at 60-foot intervals from the roof of the tunnel to the level of the towpaths, facilitated the removal of the muck. In clearing away the bench, several headings were attacked simultaneously, and more than 785 cubic yards of rock was handled in a 24-hour day.

In excavating the ground below the point at which the arch has its widest span—72 feet—some trouble was experienced in soft rock. Two methods were employed in dealing with this situation; and, as a result, this part of the tunnel work was accomplished without mishap. One method was confined to excavating the bench and to placing blocks of inverted arches, forming abutments, in shallow recesses dug at intervals for the purpose. The necessary

Engineer in charge of construction of the Rove Tunnel.



Left—Terminal point where freight can be transferred expeditiously from ships and trains to canal boats and vice versa. Right—The drawbridge over the Marseille-Rhone Canal at Caronte.



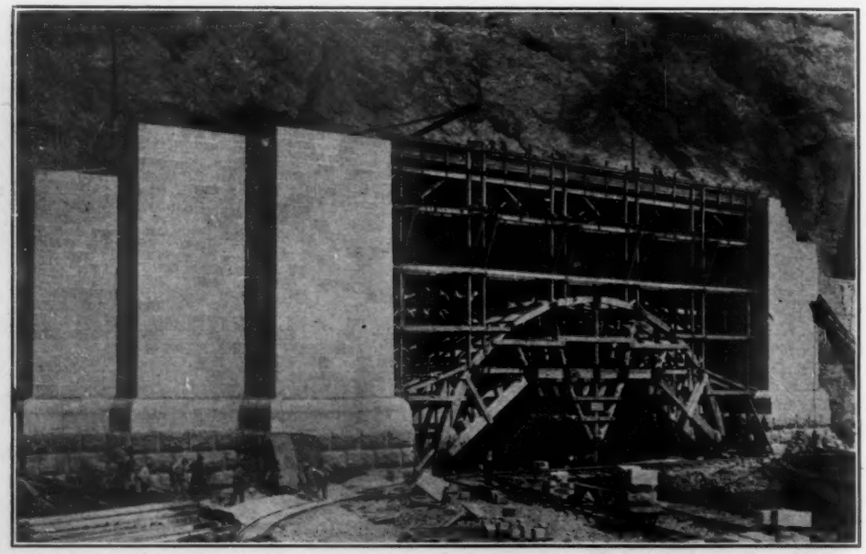
Bucyrus steam shovel excavating in the open cut of the canal in the neighborhood of Gignac.

masonry work between these abutments was then easily finished, step by step.

This procedure, however, was not considered safe throughout the last 1.25 miles of the tunnel. There it was feared that the unstable rock might cause cave-ins and endanger the security of the completed arch. To prevent this, timbered shafts were sunk every 20 feet along the tunnel line, and from the bottoms of these shafts the excavating and the reinforcing of the walls of the arch could be done in easy stages. In this way it was possible to remove the core and to do the masonry work below the surface of the towpaths without incurring the danger of collapse. Wherever this plan was followed, the roof of the tunnel was lined with concrete varying in thickness from 1.5 to 4 feet.

But bad ground was not the only obstacle that hampered progress. Numerous springs were struck—the water flowing into the tunnel from those sources attaining a volume of about 12 second-feet during the dry season and 20 second-feet during the rainy season. Owing to the fact that the tunnel floor was not built on grade, the problem of drainage proved vexatious. For this purpose there were laid iron conduits, having an aggregate length of about 2 miles. These served to divert the flow from the headings—electrically operated pumps being used to handle the water.

To supply power to the pumps, it was necessary to run a high-tension transmission line for a distance of more than 3 miles and to place transformers every 3,280 feet. An armored cable, buried on a level with the towpaths, delivered current at 300 kw. to the pumps. Exposed as those conduits were to fairly steady blasting, some difficulty was experienced in keeping them in good condition—that is, free from leaks; and, on several occasions, the electric cable had to be moved while "alive" to permit excavating to proceed. Just what this work involved can be better understood when it is known that in excess of 26,000,000,000 gallons of water had to be pumped at an expenditure of 10,000,000 francs, or 6 per cent. of the cost of driving the tunnel.



Operations at the south portal of the Rove Tunnel, with the masonry nearly finished.

As the accompanying map shows, the Rove Tunnel does not extend all the way to the Etang de Bolmon—a small body of water separated from the Etang de Berre by a narrow strip of land. For approximately 1.35 miles the canal, after leaving the northern tunnel portal, flows through an open cut, known as the Gignac Cut. This cut is 66 feet wide and, nearest the tunnel, has a maximum depth of 115 feet. Work on this cut was begun in 1912; but, owing to a lack of funds and a shortage of workmen, was not completed until sometime in 1926. Two 80-ton Bucyrus steam shovels were used to do the excavating of this cut and of the associate Marignane Basin. Under favorable conditions, these shovels were able to handle 4,000 cubic yards a day. The muck was hauled away in 9-cubic-yard-capacity dump cars, running on standard-gage track. Where hard red clay was struck, churn drills operated in advance of the shovels.

Slides, reaching a volume of 13,000 cubic yards, somewhat interfered with progress as the end of the cut was in sight. It was impossible there to hold the earthwork in place by means of covered or open drains, and it was found necessary to reinforce the revetment walls with buttresses. These were carried to a depth of 23 feet below water level and, at times, had a thickness of 13 feet. Three railway and highway bridges span this stretch of the Marseille-Rhône Canal. From La Lave, at tide water, to the south portal of the tunnel, the canal passes through another cut 328 feet long. There dredging and blasting had to be resorted to in clearing away the earth and rock; and in this work churn drills, mounted on barges, were used.

The driving of the Rove Tunnel—which permits continuous traffic in both directions of barges and lighters of 1,200 tons—called for the excavating of 3,000,000 cubic yards of material and the employment of 1,300 tons of dynamite. Besides, there were required in its construction 275,000 square yards of dressed stone, 458,000 cubic yards of masonry, and 64,000 cubic yards of concrete. The Gignac Cut necessitated the removal of about 1,500,000 cubic yards of earth; and 91,500 cubic yards of concrete were utilized in the revetment walls. In this case, only 253 tons of explosives were needed for blasting. The cost of building the Rove Tunnel amounted to 142,000,000 francs, and the cost of the Gignac Cut was 21,000,000 francs—a total of 163,000,000 francs.

All the earth and rock from the tunnel and the cut was used either in the rearing of dikes in the Harbor of Marseille or in the upbuilding of an industrial area on the shores of the Etang de Bolmon. It might be mentioned here that the Harbor of Marseille was enlarged at the same time that the Rove Tunnel was under construction. This was done in anticipation of

the increased tide of traffic that would inevitably follow the opening of this section of the Marseille-Rhône Canal.

Two compressor plants, one at each tunnel portal, furnished the air for the drills employed in driving the tunnel. These compressors were of Ingersoll-Rand make, and were of 300, 375, and 500 hp., respectively. On occasions, more than 80 "Jackhamers" were at work simultaneously in advancing the headings. Five additional units supplied air at a pressure of 1,400 pounds per square inch for the operation of compressed-air locomotives, of which there were eight on the job. One of these was a Porter engine with a drawbar pull of 7,054 pounds.

All told, approximately 32,800 feet of piping was required to deliver the air—ranging in pressure from 140 to 1,400 pounds per square inch—to the various points of use. In advancing from the south portal, the air line was carried for a distance of 3 miles—the indicated losses in pressure in this line amounting to from 2 to 2.5 pounds.

All work on the project was completed in 1926; and on April 25, 1927, with impressive ceremonies, the President of the French Republic formally opened to traffic that stretch of the Marseille-Rhône Canal extending from the Mediterranean to the Etang de Berre. After the war, that is, in 1919, the contract for finishing the tunnel was awarded to M. Léon Chagnaud, a public-works contractor of Paris, who had had considerable experience in engineering undertakings of this character. Notable among these was the first Métropolitian Tunnel under the Seine and the Loetchberg Tunnel—the latter having a length of more than 9 miles. Construction operations on the Rove Tunnel were in charge of Messrs. Bourgougnon, Bezault, Mathieu, and Gourret, all government engineers. At the time the contract was awarded it was arranged that the cost of the tunnel—then estimated at 52,000,000 francs—was to be met equally by the State and by the Marseille Chamber of Commerce. As it turned out, the last-named body has had to provide all the money needed over and above the pre-war figure.

As now conceived, the total estimated cost of the Marseille-Rhône Canal from the Harbor of Marseille to Arles will be more than 220,000,000 francs. The work still to be done will be taken in hand, step by step, as funds become available. However, if the Rhône is to be canalized and if its waters are also to be made use of for agricultural and power purposes, then the expenditures will mount to 1,000,000,000 francs.

The section of the canal between the Port de Bouc and Marseille is but part of a general scheme conceived by the Chamber of Commerce of Marseille to create an industrial area on the shores of the Etang de Bolmon that will unquestionably attract business by reason of the low-priced means of transportation offered by the canal. Under the guidance of successive presidents—Messrs. Adrien Artaud, Hubert Giraud, and Emile Tastoin—the enterprising Chamber of Commerce has also undertaken the improvement of the Etang de Caronte, which forms another natural link in the canal between Martigues, on the Etang de Berre, and the Port de Bouc. This work is now well underway, and, when completed, will enable craft from 8,000 to 10,000 tons to reach the Etang de Berre from the Port de Bouc via the Canal de Caronte. This outer harbor of the Etang de Berre will have the following characteristics: Length of quay, 7.5 miles; area for the handling of merchandise, 197.5 acres; temporary depth, 26 feet. The fairway of the Port de Bouc is eventually to be deepened to 33 feet.

Private enterprise has not been slow to appreciate the advantages of the location, and large factories, with suitable docking facilities for shipping, have already risen on both the south and the north shores of the Canal de Caronte. Besides, the Paris, Lyons & Mediterranean Railway Company is storing all its imported coal for use in the interior at this strategic point.

Much credit is due to the Marseille Chamber of Commerce for its farsightedness, not to mention courage, in furthering this momentous project and in successfully carrying it along through a period that was decidedly critical from a financial standpoint. By completing the Rove Tunnel, and by giving its support to the development of the Etang de Bolmon and the Etang de Caronte, that civic body has assured Marseille's future for years to come.

In 1926, Marseille led all the Mediterranean ports in the movement of shipping and, in that twelvemonth, there passed through that harbor approximately one-fifth of the seaborne commerce of France—superseding in that respect the Atlantic and Bay of Biscay ports. With the opening to traffic of the Rove Tunnel, this volume of traffic is bound to increase measurably, as the canal not only offers a lower-priced means of transportation but also a shorter route for freight from eastern countries destined for central France and central Europe. In other words, the Rove Tunnel links

Top—Looking outward through the southern portal of the Rove Tunnel.
Left—A finished section of the Rove Tunnel, just before admitting the water.
Right—Method of underpinning sections of the arch where the tunnel pierced soft rock.

Railway drawbridge over the Marseille-Rhone Canal at Caronte.

the Port of Marseille with a nation-wide system of inland waterways; and vessels that formerly made the trip around Portugal and Spain to Atlantic seaports can now unload their cargoes at Marseille for transportation inland on lighters and barges via the Rove Tunnel and other waterways.

NEW PROCESS OF MAKING NEWSPRINT

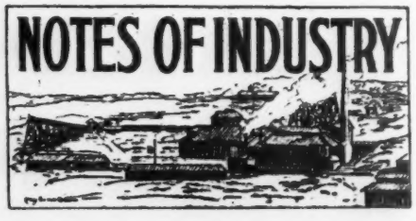
THE United States' assistant trade commissioner at Sydney has reported that, as a result of the efforts of the Council of Scientific and Industrial Research, a process has been developed whereby newsprint may be produced in Australia from domestic products at a price sufficiently low to enable that country to compete with imported material. The method evolved consists of the use of a mixture of chemical pulp, specially prepared from eucalyptus timber, together with not more than 30 per cent. of mechanical pulp made by grinding immature trees.

The disadvantage, from an Australian standpoint, of being forced to use a greater percentage of the more expensive chemical pulp than is required in the manufacture of newsprint in the United States, is asserted to be more than offset in the case of the present process by the higher yield of chemical pulp per cord of wood, by the lower cost of domestic timber, and by the fact that eucalyptus grows so rapidly and densely that in one-quarter of the time required to grow spruce for pulp wood the eucalyptus will grow at least three times as much wood per acre.

AUTOMOBILE SALES A GOOD BUSINESS BAROMETER

THE automobile industry might almost be called an index of business conditions in this country. When the automobile industry is flourishing, then factories engaged in many other lines of activity are kept busy supplying the raw materials that go into the make-up of a motor car. Just how far-reaching this effect is was brought out by the National Automobile Chamber of Commerce, which body has compiled data to show what proportion of the output of contributing industries is consumed in the 52 principal automobile plants in the United States.

To make a long story short, our automobile industry consumes 63 per cent. of all the upholstery leather made in this country; 50 per cent. of all the plate glass; 28 per cent. of the nickel; 25 per cent. of the aluminum; 13 per cent. of the copper; 14 per cent. of the finished rolled iron and steel; and 11 per cent. of the hardwood lumber. Besides, it absorbs 85 per cent. of our crude-rubber imports, as well as large quantities of upholstery cloth, paint and varnish, hair and padding, tin, lead, zinc, etc. On the face of it, a brisk demand for motor cars and trucks is bound to benefit many of our other large enterprises.



The main vertical shaft of the Kennedy Mine at Jackson, Amador County, Calif., has been sunk to a depth of 4,764 feet—making it, so it is said, the deepest gold-mine shaft on the North American continent.

The estimated consumption of all kinds of paper—including paperboard—in the United States during 1927 has been put at more than 9,000,000 tons, or 1,000,000 in excess of the 1926 demand.

A new process for preparing flax without retting is being exploited in Glasgow, Scotland, that is said to reduce the time to one-twelfth of that ordinarily required.

The need of speedways for high-powered motor cars is receiving serious consideration not only as a means of promoting safety in transit but of lessening the ever-increasing congestion on arterial highways. It is now proposed to build such a speedway along the west side of the San Joaquin Valley between San Francisco and Los Angeles. The plans call for two parallel 30-foot paved roads, with a 10-foot parking space between them, extending for a stretch of 400 miles. Besides offering a straightaway run for faster-moving cars, it will shorten the distance between those cities anywhere from 58 to 68 miles—depending on whether one travels by the inland or the coastal route.

An announcement has been made to the effect that the Third Midwest Power Conference is to be held in Chicago, Ill., from February 14 to 17, 1928, inclusive. The conference is to be of national importance; and the program to be offered will include subjects of moment to the operator and to the designer of power stations. There will also be discussed the latest ideas of the foremost experts in the country on the different problems confronting the power industry. In fact, it is planned to cover the various power interests through the operating societies, which include the American Society of Heating and Ventilating Engineers, American Society of Civil Engineers, American Society of Refrigerating Engineers, American Institute of Electrical Engineers, American Institute of Mining Engineers, American Society of Mechanical Engineers, National Electric Light Association, National Safety Council, and the Western Society of Engineers.

It is reported that the United States Navy Department has succeeded in artificially dissipating fog hanging over aviation landing fields by means of electricity. By driving electrical screens across a field it has been possible to clear paths through the fog.

The United States Bureau of Standards has made the suggestion, after suitable experiments, that those who experience eye strain after reading by unmodified artificial light may possibly find relief by using one of the so-called "artificial-daylight" lamps.

The firm of Stone & Webster, Inc., is accepting bookings for two 2-reel films entitled, *From Coal to Electricity* and *Conowingo*. The first picture shows how electricity is produced in the modern power plant, and takes the observer not only through the station but also inside each piece of machinery so that he may see just how it works. The second film features the most interesting aspects of the great 600,000-hp. hydro-electric development on the Susquehanna River near Conowingo, Md. This project is being carried out by the Philadelphia Electric Power Company under the supervision of William C. L. Eglin, vice-president and chief engineer. Bookings for the films may be arranged through Stone & Webster, Inc., of 49 Federal Street, Boston, Mass.

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—*Founded* 1896—

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EDITORIALS

'S T · CROSS ATLANTIC OUR DAYS

rts recently announced that a iness men and engineers were ..ulating arrangements for the building of a fleet of liners fast enough to make the transatlantic run in four days. In other words, the 20,000-ton craft would be able to maintain a sea speed of 32½ knots an hour—that is, travel nearly 37½ miles an hour under average conditions on the more or less stormy Atlantic. The fleet, by the way, is to consist of a sufficient number of liners to insure daily sailings.

This ambitious and even spectacular program is based upon the performance of a 20-foot model towed at various speeds in the Government model experimental basin in the Navy Yard, at Washington, D. C. The United States Shipping Board has been asked to provide a very substantial part of the sum that would be required to reproduce the test records of that model in a full-sized fleet of liners to carry the Stars and Stripes. Perhaps the Federal authorities will demand something more convincing than the showing of that 20-foot model before they obligate the funds of the Government.

For the sake of those that might be unfamiliar with the work of the Government model experimental basin, at Washington, let us say that this research plant—which owes its practical application largely to the genius of Admiral D. W. TAYLOR, of the Construction Corps of the Navy—has been the means not only of saving the taxpayer many millions of dollars but of disclosing ship-forms that could be driven at a prescribed speed with less power and, therefore, at a lower consumption of fuel than would have been the case had the power requirements of the craft been determined by other methods of calculation.

By towing 20-foot models in the basin and by recording their resistance or pull at different speeds, it has been possible to ascertain either the maximum efficient speed of propulsion or to learn how, by altering the form on a given displacement, the full-sized craft could be propelled either with less powerful engines or could be driven at a higher speed than first estimated by means of the engines originally contemplated.

This basin has enabled our naval designers to plan our fast destroyers and also to design those great cruisers of 34,800 tons that have been equipped with engines of 180,000 hp., capable of driving them at a speed of 35 knots an hour. On the face of it, then, liners having a speed of 32½ knots an hour do not seem so extraordinary, but their practical usefulness is debatable.

No matter how ships of this sort are built and engined, the maintenance of 32½ knots an hour, day in and day out, trip after trip, would inevitably entail rapid deterioration calling for frequent overhauling and probably costly upkeep. Would the price that would have to be paid by passengers for such a service to make it profitable appeal to enough people to furnish the necessary revenue? While the project is spectacular, its mechanical fulfillment is possible; but we cannot help but wonder whether or not it would pay.

WHY SHOULD THE SPIRIT OF MORTAL BE PROUD?

SIR FRANCIS YOUNGHUSBAND, eminent British military man and explorer, has written recently an imaginative book entitled, *Life on the Stars*. According to the *New York Evening Post*, Sir FRANCIS has said many things that should make the greatest of this world's great men much less pleased with themselves; and the vast majority of us, according to him, are extremely lowly beings measured by the exalted attainments of the dwellers upon some of the other planets constituting the astral universe.

The book is more or less directly due to a sudden awakening, while amid the silence and the wide spaces of the Gobi Desert, that we are by logical inference not the only living creatures in this limitless realm of planetary bodies; and because of our relative newness as an inhabited world he concludes that other worlds—millions and millions of years older—are peopled by beings that are correspondingly farther along in all that goes to make the sum of mental and physical betterment.

The one note of encouragement in this work is that we need not despair because we are, at present, so far behind the standard attained by the "world leaders" of the starry universe. Sir FRANCIS tells us that this globe of ours will probably continue to be habitable for "thousand thousand millions of years." If we continue to go forward at the rate we have in the last hundred years, perhaps we may be able to equal, if not outstrip, the peoples of a good many of those other worlds that this distinguished traveler depicts.

BOSTON TO PENSACOLA POWER SYSTEM

A SUPERPOWER zone, extending from Pensacola, Fla., to Boston, Mass., and representing the linking of 10,000,000 of electrical horsepower, is now an accomplished fact. This brings to a present climax a project brought to the attention of the general public seven years ago—a project which caused more than seven days of wonderment among a people not given to holding marvelous things long in the forefront of their thoughts.

In 1920, WILLIAM SPENCER MURRAY, a widely known electrical engineer, read a paper before the mid-winter convention of the American Institute of Electrical Engineers, and in that paper he advocated the forming of a vast interconnected power-transmission system that should cover a territory reaching north from the District of Columbia to the southern sections of Vermont and New Hampshire—the zone to extend inland from the seacoast for distances ranging from 100 to 150 miles.

Broadly stated, the purpose of the proposed superpower zone was to interlink existing central stations, as well as others contemplated, so that they could act together in meeting the shifting focal points of peak load and thus give to each associate station a longer period daily during which it could operate at capacity and sell its current. It was emphasized that this interlinking, besides promoting industry and the wider utilization of electricity, would be the means of saving annually a matter of fully 30,000,000 tons of coal within the area outlined.

The impetus given MR. MURRAY'S idea by a governmental survey—carried out under the auspices of the United States Geological Survey—and the convincing figures revealed by that research, made a profound impression upon financiers, public-service corporations, and the electrical fraternity in general. Without parade, the principle of the superpower zone has been the inspiration for much work along the lines described seven years ago; and the recent completion of certain interposed systems in the South have finally brought about a chain of interconnected generating stations over whose transmission lines current can be poured into a vast power pool for the common benefit of customers living or doing business within the far-flung territory mentioned.

This is the greatest thing of its kind yet called into being; and its economic significance is of outstanding moment. Surely, this accomplishment, in so brief a while, is the best evidence of what can be done for the common good when the reasons for it are made clear.

ANCIENT AGORA IN ATHENS TO BE EXPLORED

THE ancient market place of Athens, the Agora, is to be subjected to modern methods of exploration, thanks to a very substantial fund pledged by one or more undisclosed wealthy Americans interested in giving the whole world fuller details of that outstanding glory which was Athens' many centuries ago. This undertaking, which has been the

object of negotiations covering a period of five years or so, will bring to fulfillment archeological research urged quite a hundred years back. If the work had been taken in hand then, it is highly likely that it would have cost a great deal less than will be the case now; but it is doubtful whether, with the facilities then available, the uncovering, the excavating of this memorable site would have been as thorough as it will be under the present arrangement.

The Agora of ancient Athens was once adorned with temples dedicated to Zeus, Ares, and Aphrodite; and there also stood other imposing edifices that marked successive periods in the greatness of Greece. While despoiled and well-nigh destroyed by hostile powers at various times, still the Agora, as the central gathering place and market place of the teeming life of Athens in its prime and its decadence, must have held many valuable treasures. These undoubtedly reflected the current life, the laws, the literature, and the standards of art of different eras; and while what remains buried among the more or less buried ruins may be imperfect or of a fragmentary character, nevertheless from those remnants the archeologists may be able to reconstruct or to interpret much that is missing.

The site of the ancient Agora covers an area of about twenty-five acres, and is to a considerable extent occupied by comparatively modern buildings—many of them valued by their owners far beyond what they are really worth as habitations. It is because of this that something like $1,000,000 will have to be paid to get possession of the property for archeological purposes. All told, substantially $2,500,000 will probably be spent to carry out work that will cover a period of years—work that will have to be done carefully and yet expeditiously in order to keep expenditures within the limit set. It is conceivable that some modern excavating machinery will be utilized, because the levels at which the classical ruins or relics now lie range from a few inches to as much as thirty feet below the present ground surface. In this work, which may be rich in its historical revelations, probably pneumatic tools of one sort or another will be found of much assistance.

VISIBLE GAS EMPLOYED TO STUDY AIR CURRENTS

VISIBLE gas is used by the United States Bureau of Mines to determine the behavior of gases in mines and other underground workings. The gas employed is sulphur trioxide, which forms a dense white cloud that can be readily seen and photographed. It is an aid in determining the rate and direction of flow of air currents, the speed with which various gases mix, etc.

The apparatus in service consists of a glass tube to which is attached a rubber bulb. Fuming sulphuric acid and pumice stone are placed in the tube to generate the gas, which is emitted in puffs by squeezing the bulb.

EXPLORATIONS AND FIELDWORK OF THE SMITHSONIAN INSTITUTION IN 1926. A profusely illustrated volume of 259 pages, published by the Smithsonian Institution, Washington, D. C.

THIS interesting publication covers a far-flung field of investigation and includes papers dealing with such diversified topics as an elephant hunt in Florida; a visit to a California whaling station; explorations in Siam; collecting fossil footprints in the Grand Canyon; anthropological work in Alaska; and collecting minerals in Mexico.

A SURVEY OF AMERICAN CHEMISTRY, edited by William J. Hale and others. A book of 257 pages, published for the National Research Council by the Chemical Catalog Company, Inc., New York City. Price, $1.50.

THE present volume covers the period between July, 1925, and July, 1926, and has been compiled so that chemists of America may be given a perspective of the advances made in their several fields of research and also to bring out the importance of certain prospective researches. Each paper is by a separate author and, all told, there are 34 papers. These have been written in a way that will make most of them understandable to the non-technical reader; and the subjects discussed have to do with phases of chemistry in industry that concern well-nigh everybody.

HENLEY'S TWENTIETH CENTURY HOME AND WORKSHOP FORMULAS, edited by Gardner D. Hiscox, M. E. An illustrated work of 809 pages, published by The Norman W. Henley Publishing Company, New York City. Price, $4.00.

THIS book is a compendium of formulas and recipes that are of potential use not only in the home but in the workshop—employing the latter term in a very comprehensive sense. The volume should prove both useful and valuable to any possessor.

THE PANAMA CANAL, by Darrell Hevenor Smith. A work of 413 pages, published by The Johns Hopkins Press, Baltimore, Md. Price, $2.50.

THIS is one of the numerous monographs having to do with different departments of the United States Government, and deals particularly with the history, the activities, and the organization of the Panama Canal. The book contains a wealth of information and data, all of which make clear how thoroughly this great engineering undertaking has justified those that advocated its construction. Any one in search of facts about the Panama Canal will do well to have a look at this book.

CHEMISTRY AND THE HOME, by Harrison E. Howe and Francis M. Turner, Jr. A book of 355 pages, published by Charles Scribner's Sons, New York City. Price, $1.50.

AS the title plainly indicates, the author set out to record something of the work of chemistry in its relation to those articles which enter into home construction, home furnishing, and home operation. Therefore, there are chapters that deal with foods and nutrition, with metals in the kitchen, with glass, with fabrics, with paper, with drugs and medicines, and, of course, with perfumes and toilet articles. Finally, there are chapters that tell us about illumination, about leather, about fuels, and about chemistry in the garden—both front and back. This book will prove instructive to home dwellers, and will be found easy and entertaining reading.

THE MARKETING PROBLEM, by Edward T. Elbourne, with a foreword by Sir Josiah Stamp. A volume of 216 pages, published by Longmans, Green & Company, Ltd., New York City. Price, $4.00.

AS the author explains: "This book has been prepared primarily for the information of those British manufacturers and merchants who have not visited the United States of America within the last two or three years. American methods are viewed by many on this side of the Atlantic with a certain antagonism. So far as this exists, without adequate reason, it may possibly be modified when it is remembered that many of the best directing brains in America's industry and commerce trace their lineage back to these troubled little Islands. Anyone conversant with business conditions in both countries will readily acknowledge that the issue is essentially the utilization of brains and not merely their possession. It will be a great satisfaction to the author if the reading of this book helps to foster a regard for the United States commensurate with that regard for England so abundantly evident to the visitor."

The following copies of new publications, issued by the United States Bureau of Mines, may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C.

BULLETIN 259. Placer-mining Methods and Costs in Alaska, by Norman L. Wimmler. 236 pp. 70 figs. 55 cents.

BULLETIN 261. Resistance of Metal-Mine Airways, by G. E. McElroy and A. S. Richardson. 149 pp. 71 figs. 35 cents.

BULLETIN 268. Coal-Dust Explosion Tests in the Experimental Mine, 1919 to 1924, inclusive, by George S. Rice, J. W. Paul, and H. P. Greenwald. 176 pp. 31 figs. 35 cents.

BULLETIN 280. Petroleum Refinery Statistics 1916-1925, by G. R. Hopkins. 141 pp. 5 figs. 30 cents.

TECHNICAL PAPER 378. Precipitation of Gold and Silver from Cyanide Solution on Charcoal, by John Gross and J. Walter Scott. 78 pp. 10 figs. 15 cents.

TECHNICAL PAPER 384. Passage of Solid Particles Through Rotary Kilns, by John D. Sullivan, Charles G. Maier, and Oliver C. Ralston. 42 pp. 20 figs. 15 cents.

The War Department has been asked to approve the construction of a vehicular tunnel under the Detroit River from Detroit, Mich., to Windsor, Canada.

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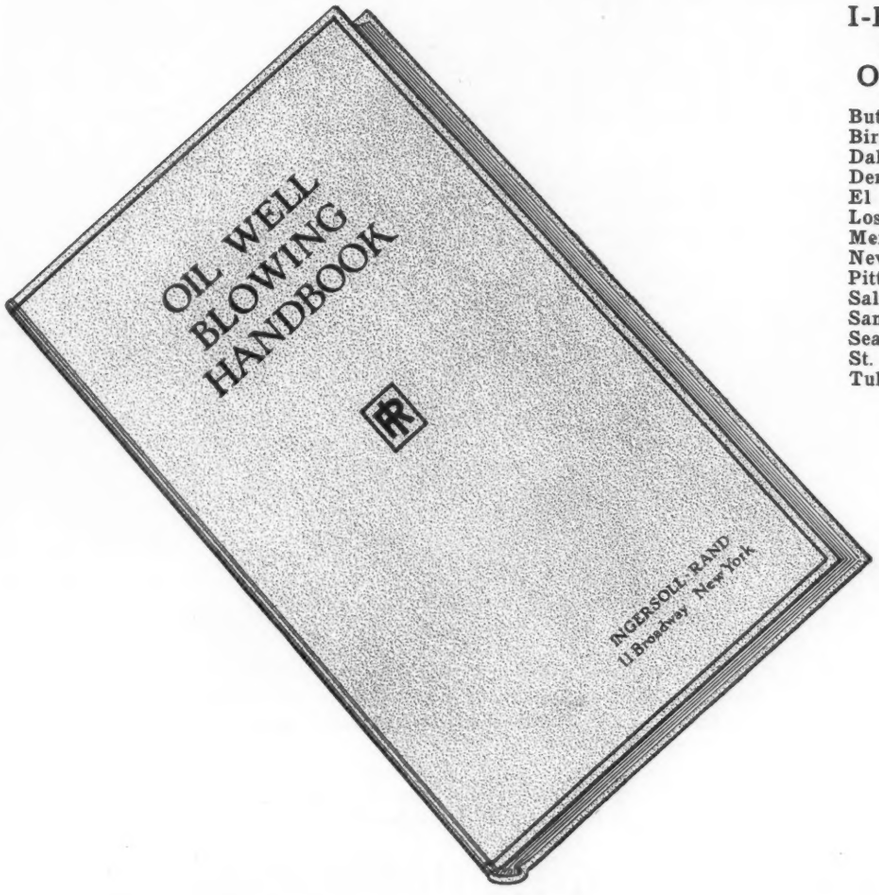

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A recent application was made for the Amtorg Trading Company, southern Russia. It consists of four 50-horsepower units directly coupled to Ingersoll-Rand air compressors.

These units embody those features which have made G-E synchronous motors famous the world over—in brief, high efficiency, ample torque, unfailing dependability, power-factor improvement, compactness, sturdy construction, and longevity.

Their advantages have been made possible by the engineering faculty, skilled artisans, and manufacturing facilities of the General Electric organization.

G-E synchronous motors are made with the same high standard of quality which is characteristic of all other apparatus identified by this monogram.

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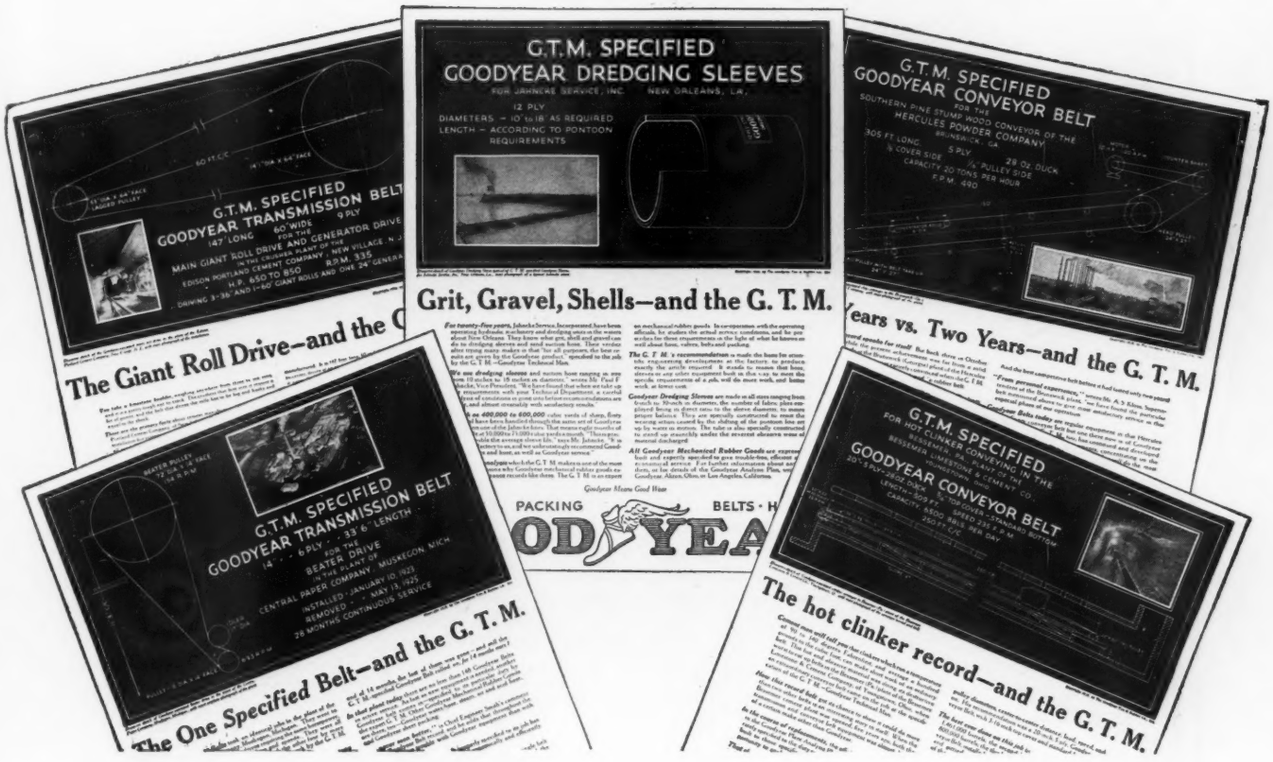


Your Belting Needs—and the G. T. M.

Good belting, of course, is the prime foundation of all successful power transmission and material conveying by belt. Yet, aren't many good belts wasting their inbuilt value on jobs to which they have been extravagantly applied? Aren't many others trying—expensively, with many a break-down, repeated troubles and frequent replacements—to perform some duty for which they are wholly unfit?

To answer these questions is to solve the great majority of industrial belting problems—problems that increase production costs and cut down on net profits. To provide that solution is the entire purpose of the Goodyear Analysis Plan and the G. T. M.—Goodyear Technical Man.

The Goodyear Analysis Plan is the scientific way of getting *the right belt* for the job. While its results are often wonderful, it is neither magic nor mystery, but only common sense, methodically applied. For, as you will agree, it stands to reason that the belt which is expertly specified, designed and built to perform a certain task is much more likely to do that job more economically, more efficiently, and last longer on it, than a belt that is bought as just so many feet of belting.

This plan has worked effectively to the benefit of industry for more than eleven years now in the specification, manufacture, application and service of Goodyear belts, hose, and other mechanical rubber goods. It is a special development of the fixed Goodyear principle to build the best value into the product and to provide the service that will help the user get all that inbuilt value out. It has functioned importantly in establishing Goodyear's present leadership in the field of industrial belting.

The G. T. M.—Goodyear Technical Man—has the responsibility of making the plant analysis. You will like him and the way he works. He comes to you with an open mind on your belting problem. He may hold an engineering degree, or a diploma from the school of hard knocks. In either case, he knows belting—has had a thorough training in its uses and design—and has the advantage of having studied belting performance under almost every conceivable service condition. A few of his actual experiences are reproduced on this page.

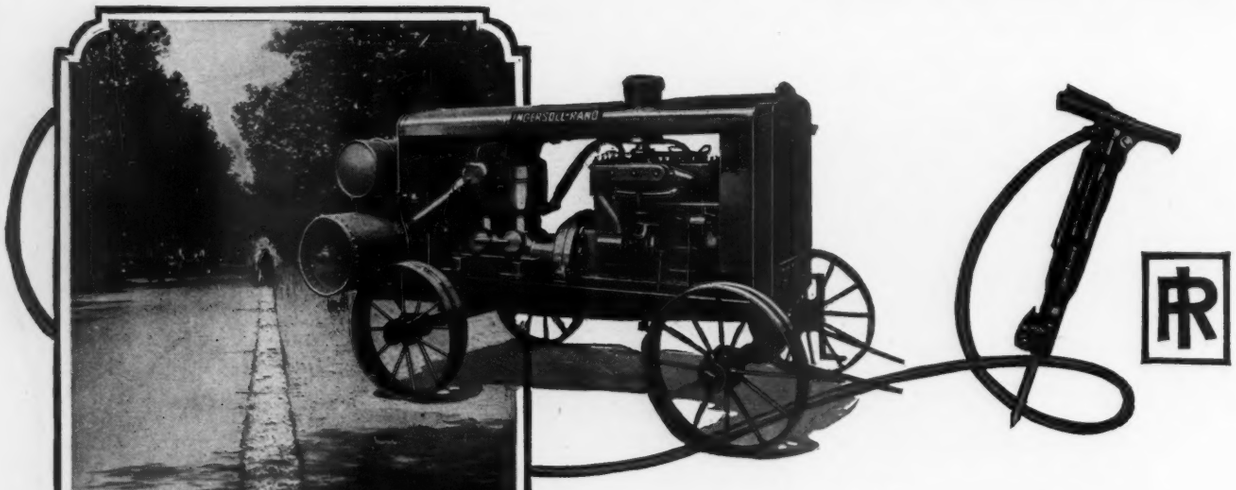
He co-operates with you, your Plant Superintendent, Factory Manager, or Engineer, in making his survey of your particular operating requirements and conditions. He carefully computes dimensions, power load, and all other factors that affect a belt's performance. He is just as interested in recommending the right belt for a single drive as he is in equipping an entire plant.

You can depend upon the recommendations made by the G.T. M. You can rely on any Goodyear Mechanical Rubber Goods he specifies—Belts, Hose, Valves and Packing—to do their work better, last longer, and cost you less in the end. To get in touch with the G.T. M. nearest your plant, or for further information about the Goodyear Analysis Plan, write to Goodyear, Akron, Ohio, or Los Angeles, California.

Goodyear Means Good Wear

VALVES · PACKING BELTS · HOSE

GOODYEAR



Time and labor savers—the Ingersoll-Rand Portable Compressor and Paving Breaker.

The I-R Paving Breaker will do the work of 15 men with hand sledges and steels.

This Outfit Paid for Itself in Two Weeks' Time

A WELL-KNOWN public utility company recently undertook a job that meant breaking out a strip of concrete paving and sidewalk almost a mile long. This figure must actually be doubled, since both sides of the street were torn up.

Two I-R Paving Breakers and a Type 20 Portable Compressor were rushed into service. In a little more than two weeks (8 hours per day), the demolition work was completely finished and the outfit moved along to another job.

The superintendent of the company, who was in constant touch with operations, states that the compressor and Paving Breakers paid for themselves on this one job alone.

You can make these savings, too. There is a compressor and a mounting for every type of work, and a complete line of air-operated, labor-saving tools. Upon request we shall be glad to send you full and authentic data showing how this equipment is reducing costs on other jobs in the field.

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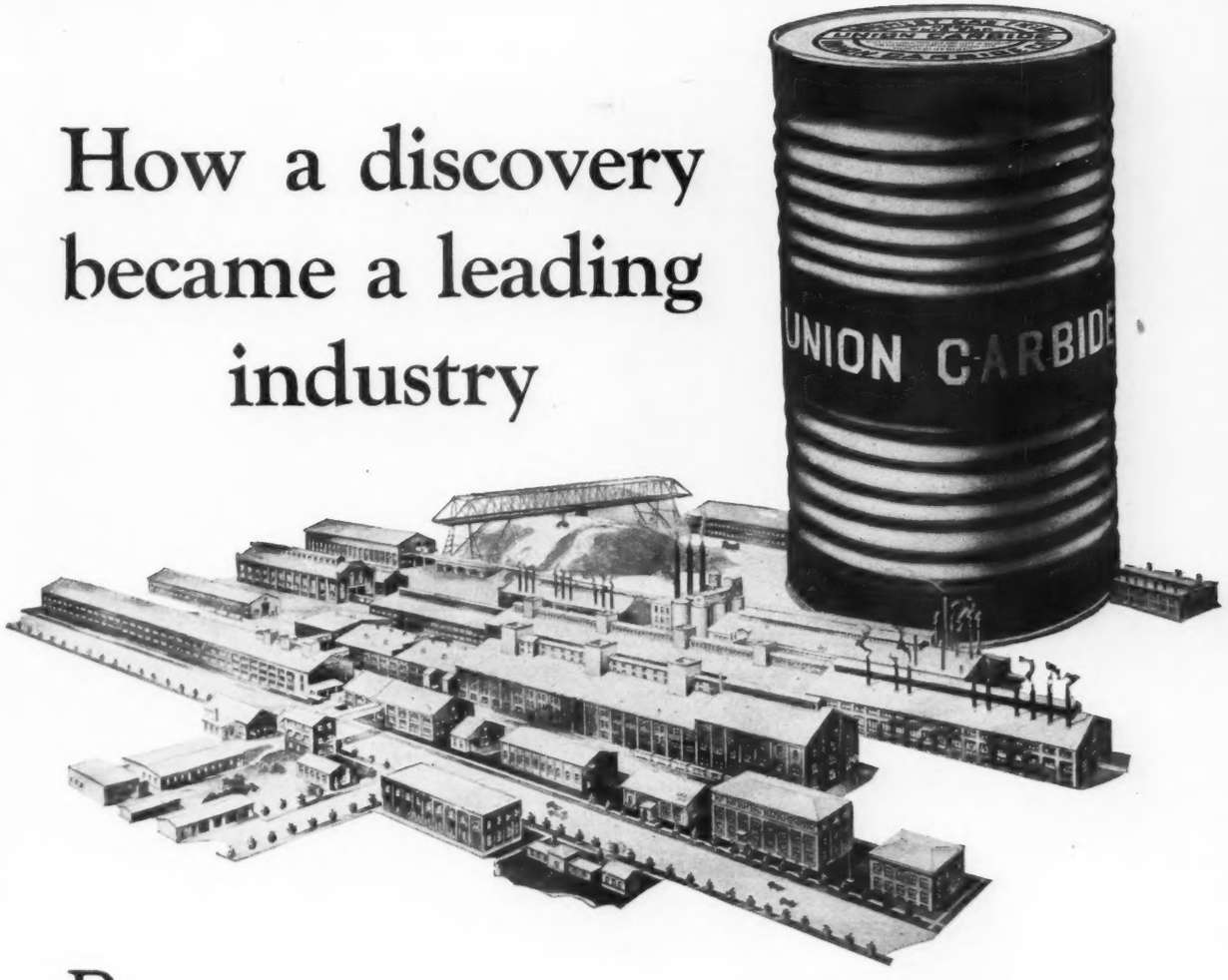
Ingersoll-Rand

How a discovery became a leading industry



BACK in the early nineties a discouraged group of experimenters stood around an electric furnace. Time after time they had tried to produce aluminum without success.

As a last resort they thought of making metallic calcium first and using that to make aluminum. So they fired a mixture of coal tar and lime. When they quenched the molten product in water, it began to generate a gas which turned out to be, not hydrogen, as they first thought, but acetylene. And the substance they had made was calcium carbide.

After exhaustive experimental work, which involved creating a new technology, this newly discovered substance was made in large quantities, and UNION CARBIDE became a commercial product.

Back of the product—as a guarantee of quality and uniformity—are more than thirty years of careful and consistent investigation by the same organization. That is one reason why Union Carbide gives the highest gas yield and why it has become the standard calcium carbide.

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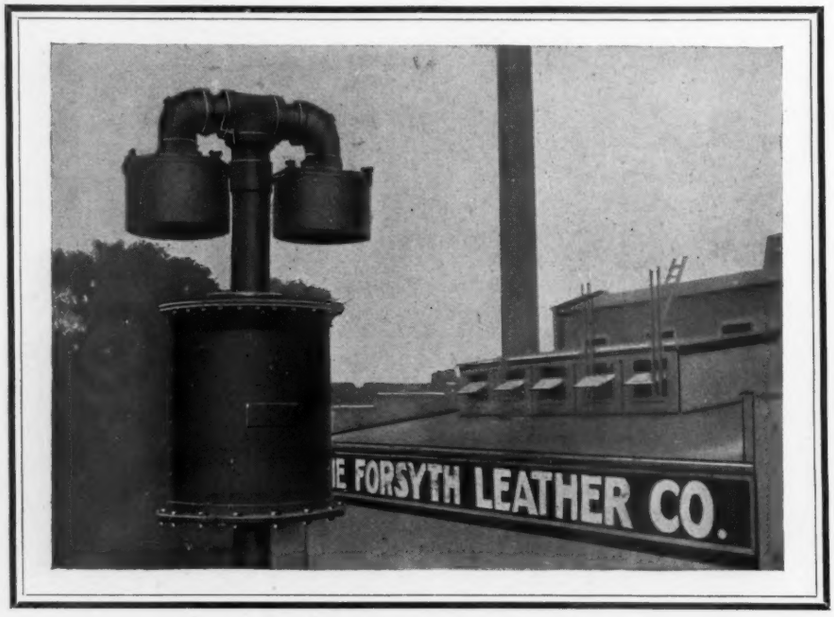

Maxim Silencer quieting a compressor intake at the Forsyth Leather Company plant, Wauwatosa, Wis. Incidentally, this company writes: " . . . our only regret is that we didn't get it sooner."

Silence Is A Tangible Asset— *Anywhere*

There is no question as to the trouble noise causes.

Complaints from the neighbors, perhaps with injunctions from the authorities. Tangled-up telephone conversations, possibly with costly results. Warning signals in the shops missed by workmen—. Noise unquestionably is a source of ill-will, mistakes and danger.

So can there then be any doubt as to the value of Silence?

Maxim Silencers are doing their full share toward making living and working conditions better and safer. If there is any air, gas or steam noise in or around your plant, you need a Maxim Silencer.

Write us for recommendations.

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Our representatives will be glad to tell you all about the Maxim Silencer and how it will eliminate certain noise problems in your plant.

For oil and gas engines, air compressors, uniflow steam engines, positive pressure blowers, reducing and safety valves, and other equipment having noisy intakes or exhausts, use Maxim Silencers.

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Products

DRY TYPE POSITIVE FILTERS for completely removing all kinds of dust and foreign matter from small or large volumes of air at atmospheric or at higher or lower pressures. FILTERS for removing dirt, scale, rust, water, and oil from pipe lines.

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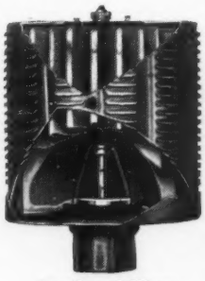


Sectional View

Operation

Protectomotor Air Filters, by an unique arrangement and skillful mechanical construction, provide a large filtering surface within a relatively small space. The intake air currents move parallel to the filtering surface at very low velocity, so that the dust and dirt are not packed on to the felt, but remain in a loose and porous condition, which permits the air to pass through the accumulated dust and dirt quite as readily as through the felt itself. Dust and dirt do not enter pores of felt, which is of extremely fine texture.

Efficiency

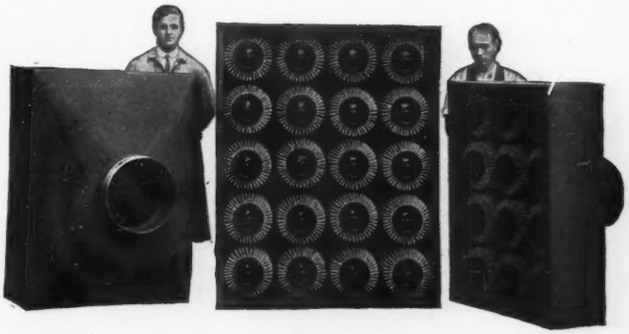
Due to the low air velocity and the fine texture of the felt, practically complete removal of dust is obtained. An actual efficiency of 99.9% is maintained, even on fine air-floated dust. Efficiency is not affected by continuous service, nor by any change in volume of air passed.

Pressure Drop

Resistance to the flow of air is less than 3/8-in. water gauge when operated at rated capacity. Less pressure drop, when required, may be obtained by using an oversize filter.

Cleaning

Under ordinary conditions filters operate from six months to a year without attention. A special cleaning device is attached to each filter unit that enables the material collected on the filtering surface to be very quickly and completely removed by compressed air. The material may be reclaimed, if valuable, without contamination, since no sticky or adhesive oils are used. No spare parts or cleaning tanks are necessary. Less than two minutes' time, per 1000 cu. ft. per min. of air capacity, required for cleaning. Filters may be cleaned while in operation, without removing filtering units.



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Protectomotor

D-250-A Type—Cap. 250-300 cu. ft. per min. Height, 14 in.; diam., 13 in.; weight, 18¼ lb.; outlet, 4 in. female. Standard pipe thread.

D-350-A Type—Cap. 350-400 cu. ft. per min. Height, 14 in.; diam., 17 in.; weight, 27 lb.; outlet, 5 in. female. Standard pipe thread.

Application

All filter units or filter assemblies are complete in weatherproof housings, ready to attach to air intake pipe. Standard pipe nipples or pipe flanges provided as specified.

Uses

Filters are suited to all types of air-using machinery, such as air compressors, internal combustion engines, Diesel engines, blowers, electric motors, pneumatic systems, air brakes, etc.; also for dust recovery, ventilating, and any other purpose where clean air is desired.

Model C-0	Model C-1	Model C-2	Model C-3	Model C-4	Model C-4A	Model C-5
*C.f.m. 15-20	*C.f.m. 40-50	*C.f.m. 60-65	*C.f.m. 75-80	*C.f.m. 100-110	*C.f.m. 150-160	*C.f.m. 200-225
Diam. 3½ in.	Diam. 4½ in.	Diam. 5½ in.	Diam. 5½ in.	Diam. 6⅜ in.	Diam 7½ in.	Diam. 9 in.
Height 4½ in.	Height 5½ in.	Height 7 in.	Height 8½ in.	Height 9 in.	Height 10½ in.	Height 12½ in.
Weight 8 oz.	Weight 16 oz.	Weight 26 oz.	Weight 34 oz.	Weight 38 oz.	Weight 62 oz.	Weight 96 oz.
Thread 1 in.	Thread 1¼ in.	Thread 1½ in.	Thread 1¾ in.	Thread 2 in.	Thread 2½ in.	Thread 3 in.

Range of Sizes for Small Compressors, Blowers, Electric Motors, Internal Combustion Engines, etc.

*C.f.m. is the cu. ft. of free air per minute (capacity).
Note: Height is the over-all dimension including thread; thread is standard pipe thread.

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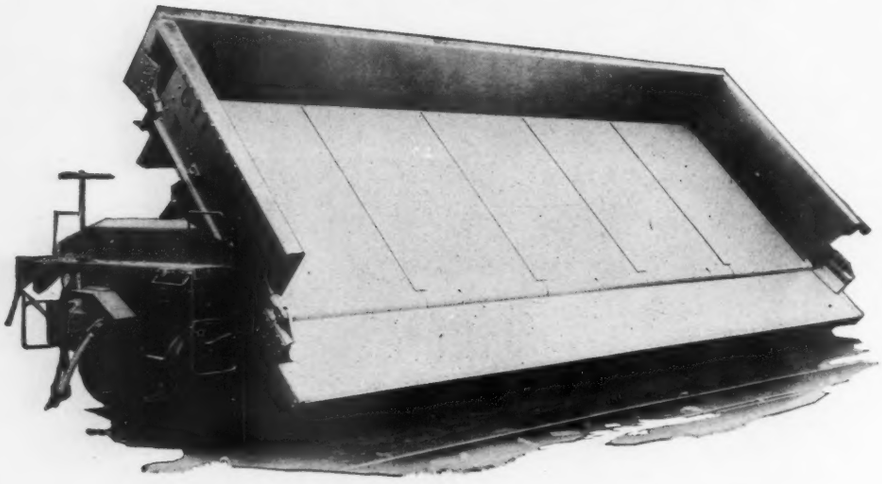

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Bulletin No. 27-QCM explains these and other features of design which will result in re-orders after trying. We want you to see this bulletin. Please write for it.

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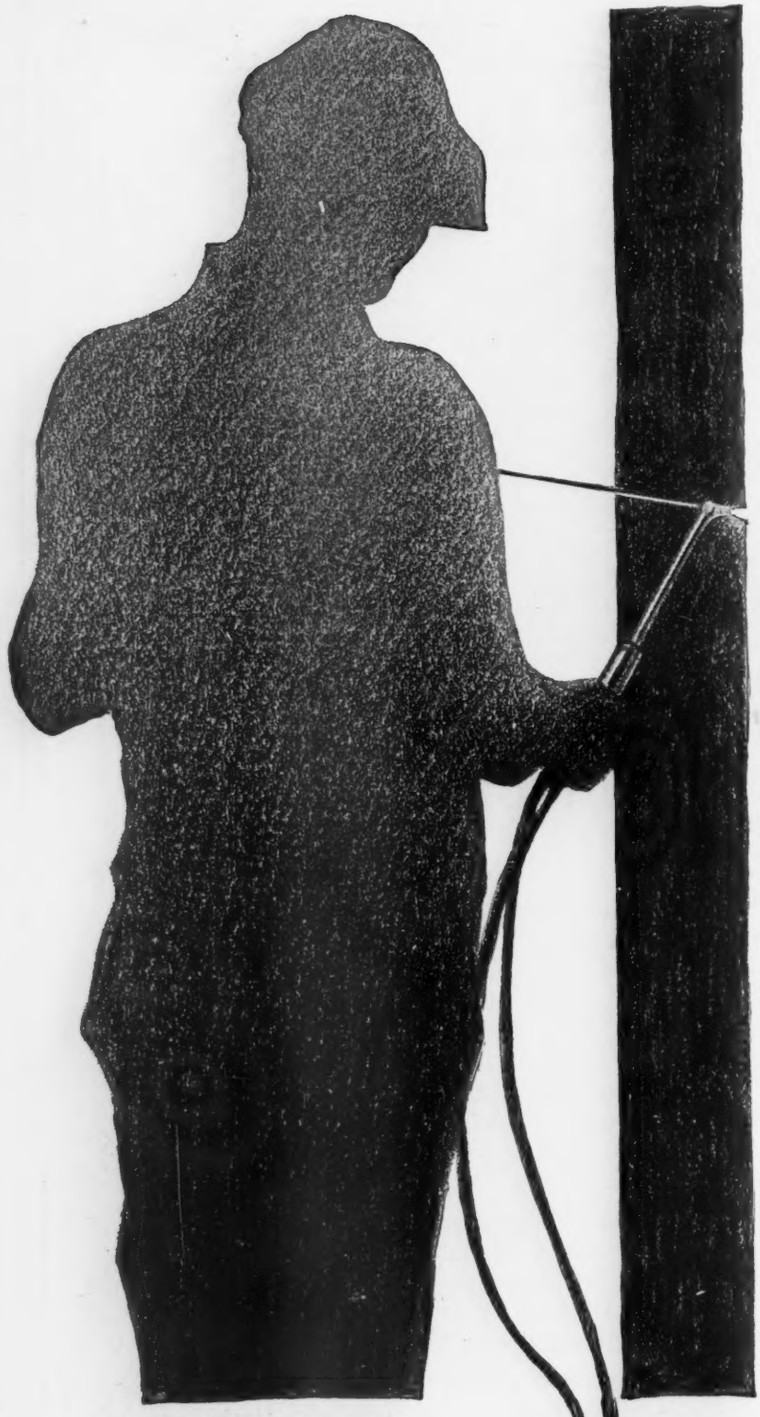
Aurora, Illinois, U. S. A.



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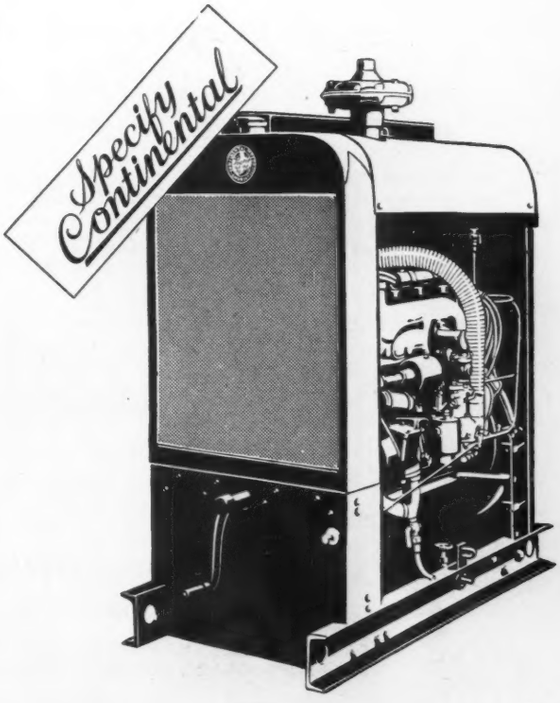

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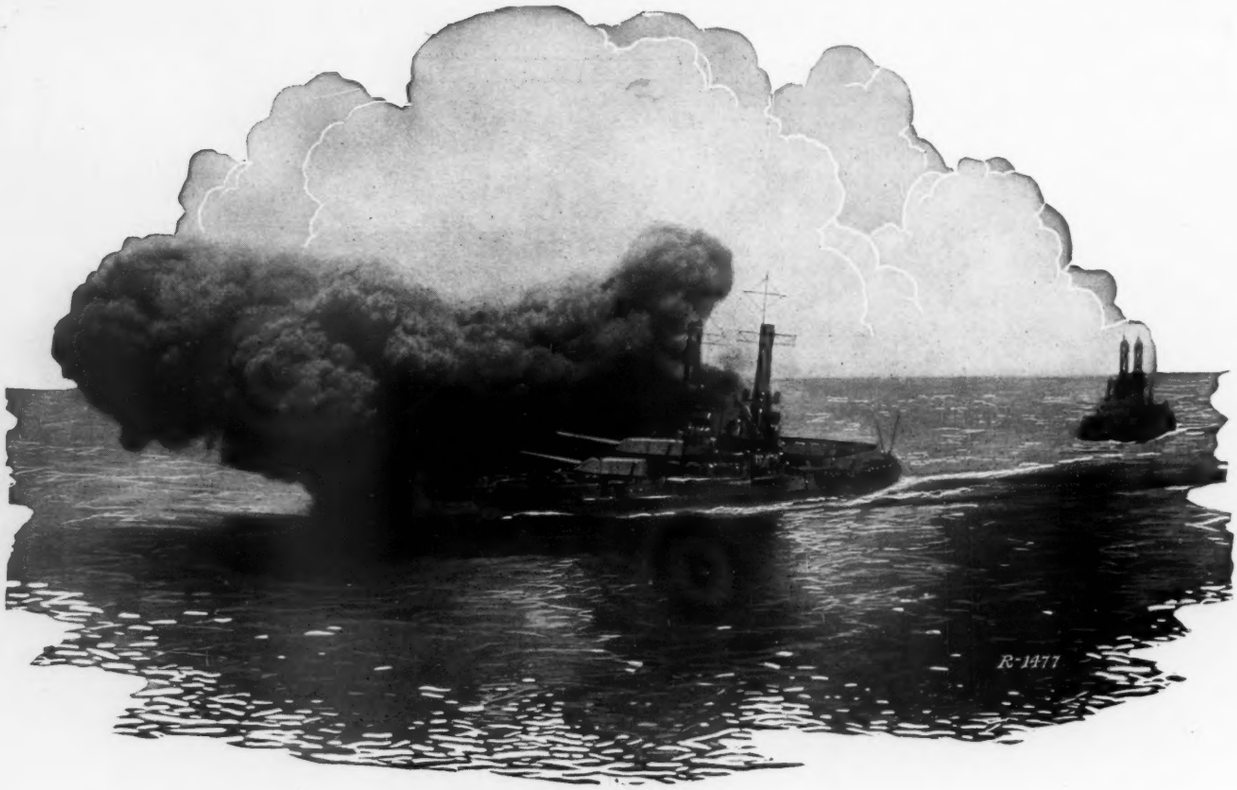

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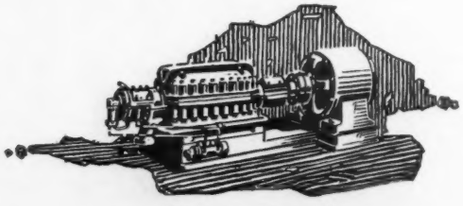

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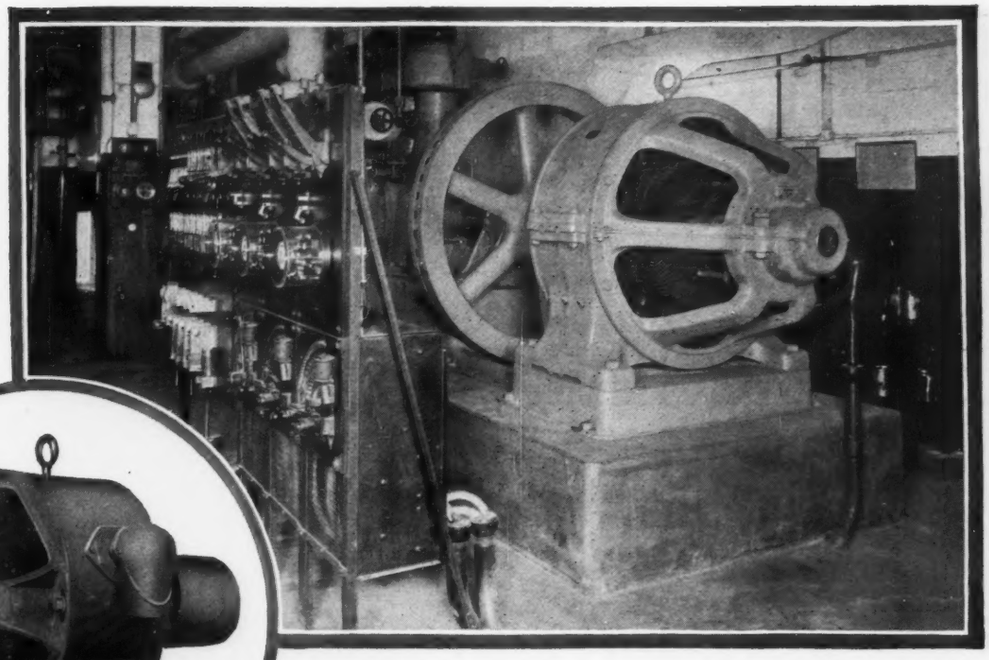

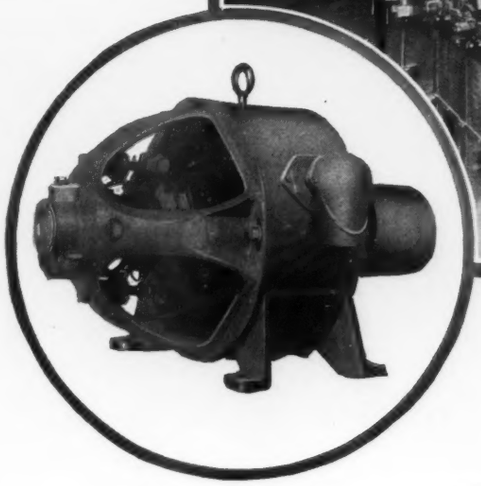

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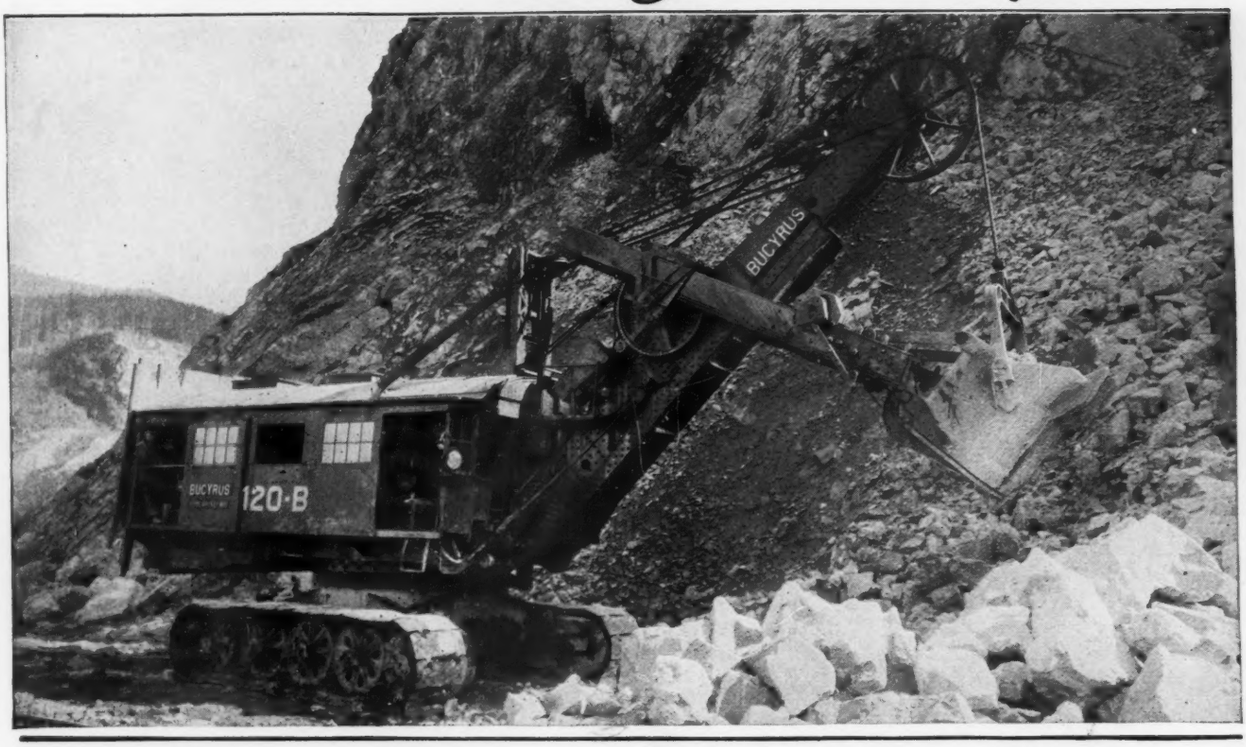

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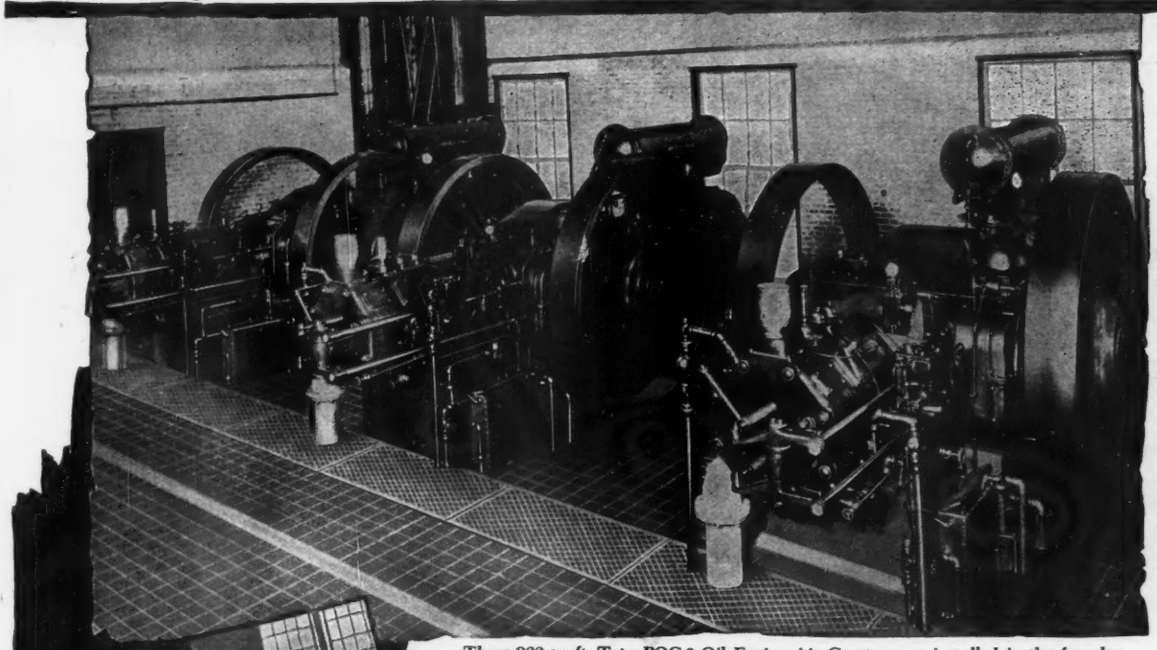

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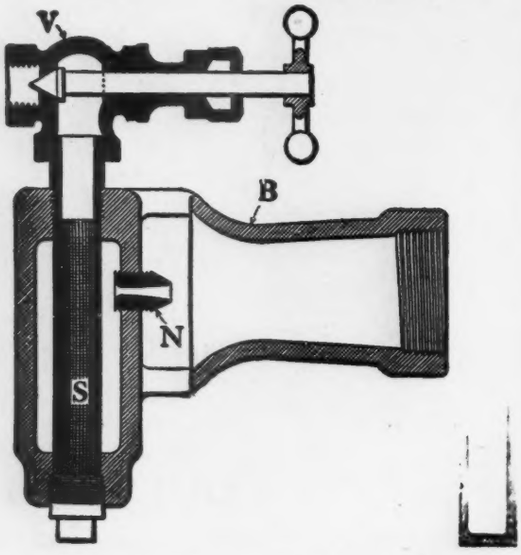

Forge Blower (Type F B) shown above.

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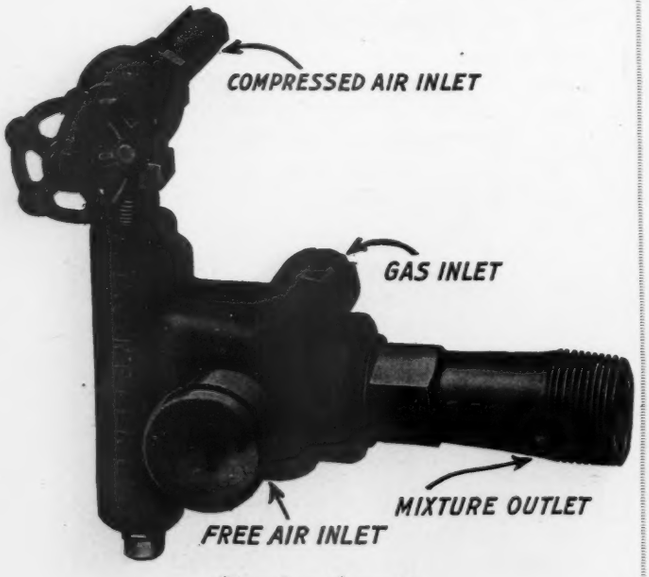
Bulletin B describes fully.



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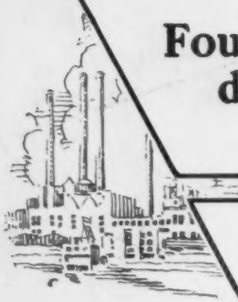

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